This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

~~614.06~~
~~S227~~
RA421
S3
V.15
1894

STANFORD UNIVERSITY LIBRARIES

THE SANITARY INSTITUTE, INCORPORATED 1888.
SALUS GENERIS HUMANI.

1894.

JOURNAL

OF

THE SANITARY INSTITUTE.

(Being Volume XV. of the Transactions of The Institute.)

1894.

LONDON:
OFFICES OF THE SANITARY INSTITUTE, MARGARET STREET, W.
EDWARD STANFORD, 26 & 27, COCKSPUR STREET,
CHARING CROSS, S.W.

1895.

LIBRARY OF THE
LELAND STANFORD JR. UNIVERSITY.
a.29928

EDITING COMMITTEE.

J. F. J. Sykes, D.SC., M.D., *Chairman.*

A. Wynter Blyth, M.R.C.S.

Major Lamorock Flower.

Henry Law, M.INST.C.E.

G. J. Symons, F.R.S.

E. White Wallis, F.S.S., *Secretary.*

The Institute is not responsible for the facts and opinions advanced in the Addresses, Papers, and Articles published in the Journal.

JCONS.'93 - P.D.

Kenny & Co., Printers, 25, Camden Road, London, N.W.

TABLE OF CONTENTS.

HISTORY OF THE SANITARY INSTITUTE.

PAGE
Introduction 1

PROCEEDINGS OF THE INSTITUTE—PAPERS READ.

The Etiology, Spread and Prevention of Diphtheria, by R. Thorne Thorne C.B., F.R.S. 7
The Sanitation of Places where Food is Stored and Prepared, by F. J. Waldo, M.A., M.D., D.P.H. 21
Sanitary Building Construction, by Keith D. Young, F.R.I.B.A. . . . 37

Annual Report, and Statement of Accounts, 1893 53
Obituary Notice—Inspector-General R. Lawson, LL.D. 80

The Construction of Roads and Streets from a Sanitary Point of View, by Lewis H. Isaacs, F.R.I.B.A. 137

LECTURES IN METEOROLOGY IN RELATION TO HYGIENE—

Meteorological Instruments and Sanitary Work, by G. J. Symons, F.R.S. 157
Temperature of Soil, Water and Air, by H. R. Mill, D.SC., F.R.S.E. . 169
Barometrical Conditions and Air Movements, by R. H. Scott, F.R.S., F.R.MET.SOC. 188
Moisture: its Determination and Measurement, by W. Marriott, F.R.MET.SOC. 200
Climate in Relation to Health, by C. Theodore Williams, M.A., M.D., F.R.C.P. 216
Fog, Cloud and Sunshine, by F. Gaster, F.R.MET.SOC. 231

CONGRESS AT LIVERPOOL.

Inaugural Address, by Sir Francis Sharp Powell, Bart., M.P. 329
Address to Section I., Sanitary Science and Preventive Medicine, The Etiology of Typhoid Fever, by E. Klein, M.D., F.R.S. 343
Address to Section II., Engineering and Architecture, by G. F. Deacon, M.INST.C.E. 353
Address to Section III., Chemistry, Meteorology, and Geology, by Thomas Stevenson, M.D., F.R.C.P. 372
Address to Conference on The Sanitation of the Passenger and Mercantile Marine Service, by Sir William Bower Forwood, J.P. 382
Address to Conference of Medical Officers of Health, by C. E. Paget, M.R.C.S. 386
Address to the Conference of Municipal and County Engineers, by A. M. Fowler, M.INST.C.E. 403

PAGE
Address to the Conference of Sanitary Inspectors, by Francis Vacher, F.R.C.S. 409
Address to the Conference of Ladies on Domestic Hygiene, by The Lady Mayoress of Liverpool. 413
Lecture to the Congress, by G. B. Longstaff, M.A., M.D., F.R.C.P. . . . 417
Address to the Working Classes, The Prevention of Tubercular Disease, by Sir James Crichton-Browne, M.D., LL.D., F.R.S. 430

SECTION I.—SANITARY SCIENCE AND PREVENTIVE MEDICINE.

Infant Mortality and Female Labour in relation to Factory Legislation, by George Reid, M.D. 497
The Protection of the Health of Female Workers, with special reference to Pregnancy and Wet Nursing, by Hugh Richard Jones, M.A., M.D., B.SC., D.P.H. 511
The Position of the Study of Industrial Diseases. Its past Neglect and its Scope, by J. T. Arlidge, M.D.Lond., F.R.C.P.Lond. 517
The Spread of Typhoid Fever by Sewers, by Prof. A. Roche . . . 520
Pawnbroking Establishments as a Source of the Spread of Disease, by Prof. A. Roche 527
The Theory and Practice of Disinfection by Heat, by Wolf Defries, B.A., M.I.MECH.E. 528
Disinfection, by W. Daley 532
The Teaching of Hygiene in Elementary Schools, by Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S. 534
The Laws relating to the acquisition of Land for Isolation Hospitals, Workmen's Dwellings, and Public Improvements, by Alderman Charles Burt, J.P. 541
Quarantine in the Argentine Republic, by F. P. Hansen 552
Jaundice and Bile-Staining as a sign of disease in meat, by R. Sydney Marsden, M.B., D.SC., D.P.H., F.R.S.ED. 557
Cholera in Hull, 1893 from an Inspector's point of view, by W. H. Curtin 559
The Prevention of Mental and Nervous Diseases, by James Shaw, M.D. 564
Sanitary Insurance, by G. Walter Steeves, B.A., M.D. 565
The Burial of the Dead, by C. H. Cooper, ASSOC.M.INST.C.E., A.R.C.SC.I. 567

SECTION II.—ENGINEERING AND ARCHITECTURE.

Water Supply, by Prof. Henry Robinson, M.INST.C.E., F.G.S., F.S.I. . . 575
The Water Supply of the Borough of St. Helens, Lancashire, from Wells in the New Red Sandstone, by Prof. Edward Hull, F.R.S., F.G.S. . 578
River Pollution, by William Spinks, ASSOC.M.INST.C.E. 585
The Housing of the Working Classes: Sanitary Powers relating thereto, in Liverpool, by W. Goldstraw 605
The Housing of the Working Classes: Tenement Houses, or Dwellings in Flats, by H. Percy Boulnois, M.INST.C.E. 611
The vital difference between well managed and neglected Sewage Farms, by Lt.-Col. Alfred S. Jones V.C., ASSOC.M.INST.C.E. 628

PAGE
Willow Farming as a profitable means of utilizing Sewage Effluent, by Arthur Kent . . . 635
The Purification of Air emitted from Hospitals for the treatment of Infectious Diseases, by William Henman, A.R.I.B.A. . . . 641
The Nation's Wealth, by Robert Williams, A.R.I.B.A. . . . 652
Domestic Boiler Explosions and Cylinder Collapses, their Cause and Cure, by James Walker . . . 663
The Tub and Pail System, by Geo. J. C. Broom, M.INST.C.E., F.G.S. . . . 664
The Purification of Sewage Water for its use for Steam and Condensing Purposes, by Alderman Noton . . . 674
The Purification of Sewage and Foul Waters by means of the Magnetite Filter, by W. Darley, F.S.I. . . . 678
Lowcock's System of Sewage Filtration, by Sidney R. Lowcock, ASSOC. M.INST.C.E. . . . 685

SECTION III.—CHEMISTRY, METEOROLOGY, AND GEOLOGY.

The Application of Electrolytis to the Detection of Mineral Poisons, by Charles A. Kohn, PH.D., B.SC. . . . 691
Hygrometrical Readings taken in Cotton Mills, and their Reductions, by W. W. Midgley, F.R.MET.SOC. . . . 694
The Health of the Workmen in Chemical Factories, by A. E. Fletcher, F.I.C., F.C.S. . . . 702
Cold Storage: Its effects upon our food supply, by Frank Tate . . . 731 ✓
The Atmosphere of Liverpool, by T. Lewis Bailey, PH.D., and Charles A. Kohn, PH.D., B.SC. . . . 742
Notes on Town Smoke, by Hubert L. Terry, F.I.C. . . . 744
The Application of the Simultaneous Method of observing Chimneys in Bolton and Oldham, by Herbert Fletcher . . . 751
Closing General Meeting of Congress . . . 462
Awards made by the Judges at the Exhibition . . . 86, 463

ARTICLES.

A Contribution to a Bibliography of Hygiene, by G. J. Symons, F.R.S., 89, 275
The Possibility of the Spread of Disease through the River Waters Supplied to London; a review of the evidence given by the Bacteriological witnesses before the Royal Commission on Metropolitan Water Supply, by Louis C. Parkes, M.D., D.P.H. . . . 243
Hydraulic Formulæ, by Henry Law, M.INST.C.E. . . . 282

REVIEWS OF BOOKS AND PARLIAMENTARY PAPERS—

STEVENSON & MURPHY'S HYGIENE.

Vital Statistics, by Arthur Newsholme, M.D., D.P.H. . . . 108
Warming and Ventilation, by Henry Law, M.INST.C.E. . . . 110
Sanitary Law, Vol. III., by A. Wynter Blyth, M.R.C.S., Barrister-at-Law 759

SEWAGE DISPOSAL IN THE UNITED STATES. (J. W. Rafter and W. N. Baker). By Prof. Henry Robinson, M.INST.C.E. . . . 257

NOTES ON SANITATION ABROAD.

PAGE
Progress of Public Health Work at Budapest, by Prof. Dr. Fodor . . 112
Hygiene at Paris and in France generally, by Dr. Emile Vallin . . 259
Sanitary Matters in the United States, by Col. G. E. Waring, M.INST.C.E. 264
Eleventh International Medical Congress, Rome, 1894, by Dawson Williams, M.D. 266
Eighth International Congress of Hygiene at Budapest, by Paul F. Moline, M.D. 272
Report of International Congress of Hygiene, Budapest, by J. F. J. Sykes, D.SC., M.D. 471

NOTES ON LEGISLATION AND LAW CASES.

Disposal of Sewage—Diseased Meat—Filthy Accumulations—Sale of Foods and Drugs, by Prof. A. Wynter Blyth 117
Sewer Grating—Sewers—Obtaining Samples of Milk—Abatement of Nuisance—Definition of Sewer 288
Water Supply—River Pollution 480
Definition of Drain—Cleansing of Streets. 760

General Notes 132, 300
Meetings held 85, 307, 484, 765
Forthcoming Meetings of the Institute 129, 309, 485, 766
Programme of Liverpool Congress 310
Fellows, Members, and Associates elected 76, 322, 491, 768
Contributions and Additions to Library 81, 325, 492, 772
General Index 777

LIST OF PLATES.

PAGE

Map of England showing the distribution of Diphtheria 8

Diagram of Barometer, Thermometer, Rain, and Wind, at Camden Square, London, during March, 1894 168

Saussure's Hair Hygrometer, Regnault's Hygrometer, Daniell's Hygrometer 201

Dine's Hygrometer, Dry and Wet Bulb Thermometer........................ 202

Beckley's Self-Recording Rain Gauge 208

Map of England showing distribution of Rainfall 208

Richards' Self-Recording Rain Gauge 209

Diagram illustrating "Drain" and "Sewer" 300

Plans of Workmen's Dwellings 624

Apparatus to prevent the Explosion of Domestic Boilers 663

Plan of "Magnetite" Heaton Mersey Filter Beds 679

Plans showing General Arrangement of the Liverpool Cold Storage and Ice Company 736

Diagram showing number of Sheep consumed per annum in the United Kingdom and Hundredweights of Beef 740

Diagram showing fluctuations in value of Frozen Meat, &c., during the six years 1887—1892 741

Photographs of Three Shades of Smoke used as Standards of Observations 752

Officers of the Institute for 1894-95.

Patroness.

H.R.H. THE DUCHESS OF ALBANY.

President.

HIS GRACE THE DUKE OF WESTMINSTER, K.G.

Past President.

HIS GRACE THE DUKE OF NORTHUMBERLAND, K.G., D.C.L., LL.D.

Vice-Presidents.

RIGHT HON. EARL FORTESCUE.
RIGHT REV. F. TEMPLE, D.D. (Lord Bishop of London).
SIR F. ABEL, K.C.B., D.C.L., F.R.S.
SIR HENRY W. ACLAND, Bart., K.C.B., M.D., D.C.L., F.R.S.
SIR DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.
SIR G. M. HUMPHRY, M.D., F.R.S.
SIR W. GUYER HUNTER, K.C.M.G., M.D.
SIR FRANCIS SHARP POWELL, Bart., M.P.
SIR ROBERT RAWLINSON, K.C.B.
SIR HENRY THOMPSON, M.B.
THOMAS TWINING.
A. WATERHOUSE, R.A.

Treasurer.

Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.

Registrar.

G. J. Symons, F.R.S.

Council.

Ernest Turner, F.R.I.B.A., *Chairman.*

R.W. Peregrine Birch, M.INST.C.E.
Prof. A. Wynter Blyth, M.R.C.S., L.S.A.
H. H. Collins, F.R.I.B.A.
Prof. W. H. Corfield, M.A., M.D. OXON, F.R.C.P.
Sir Thomas Crawford, K.C.B., LL.D., Q.H.S., M.D.
Santo Crimp, M.INST.C.E., F.G.S.
Thomas W. Cutler, F.R.I.B.A.
T. de Courcy Meade, M.INST.C.E.
Rogers Field, B.A., M.INST.C.E.
Major Lamorock Flower.
Prof. A. Bostock Hill, M.D., D.P.H.
Baldwin Latham, M.INST.C.E., F.G.S., F.S.S.
Henry Law, M.INST.C.E.
E. G. Mawbey, ASSOC.M.INST.C.E.
A. Newsholme, M.D., M.R.C.S., L.S.A., D.P.H.
Prof. J. Lane Notter, M.A., M.D., D.P.H.
Louis Parkes, M.D., D.P.H.
J. Wallace Peggs, ASSOC.M.INST.C.E.
G. V. Poore, M.D., F.R.C.P.
G. Reid, M.D., D.P.H.
Prof. H. Robinson, M.INST.C.E.
Edward Seaton, M.D., F.R.C.P.
H. Saxon Snell, F.R.I.B.A.
J. F. J. Sykes, D.SC., M.D.
Dawson Williams, M.D.

Auditors.

Magnus Ohren, ASSOC.M.INSTC.E.
Alfred Lass, Wood & Co.

Hon. Solicitor.

Basil Field, B.A.

Hon. Librarian.

Louis Parkes, M.D., D.P.H.

Bankers.

The Union Bank, Regent St. Branch.

Secretary.

E. White Wallis, F.S.S.

Congresses held by the Institute.

LEAMINGTON, 1877.

President.—B. W. RICHARDSON, M.D., LL.D., F.R.S.

Presidents of Sections.

Section I.—EDWIN CHADWICK, C.B.
„ II.—GEORGE WILSON, M.A., M.D., F.C.S.
„ III.—R. BRUDENELL CARTER, F.R.C.S.

Honorary Local Secretaries—JAMES THOMPSON, M.D., and JOSEPH S. BALY, M.R.C.S., F.L.S.

STAFFORD, 1878.

President.—EDWIN CHADWICK, C.B.

Presidents of Sections.

Section I.—B. W. RICHARDSON, M.D., LL.D., F.R.S.
„ II.—HENRY DAY, M.D., F.R.C.S.

Honorary Local Secretaries—WILLIAM ELLIS CLENDINNEN and H. B. LIVINGSTON.

CROYDON, 1879.

President.—B. W. RICHARDSON, M.D., LL.D., F.R.S.

Presidents of Sections.

Section I.—ALFRED CARPENTER, M.D., M.R.C.P.Lond., C.S.S.Camb.
„ II.—CAPTAIN DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.
„ III.—G. J. SYMONS, F.R.S.

Honorary Local Secretaries—H. J. STRONG, M.D., and ROBERT HALL.

EXETER, 1880.

President.—THE RIGHT HON. EARL FORTESCUE.

Presidents of Sections.

Section I.—PROF. DE CHAUMONT, M.D., F.R.S.
„ II.—R. RAWLINSON, M.INST.C.E., C.B.
„ III.—SIR ANTONIO BRADY.

Honorary Local Secretaries—H. PERCY BOULNOIS, M.INST.C.E., and E. J. DOMVILLE, M.R.C.S.E.

NEWCASTLE-UPON-TYNE, 1882.

President.—CAPT. DOUGLAS GALTON, R.E., C.B., D.C.L., F.R.S.

Presidents of Sections.

Section I.—DENIS EMBLETON, M.D., F.R.C.S.
„ II.—H. LAW, M.INST.C.E.
„ III.—ARTHUR MITCHELL, M.A., M.D., LL.D., F.R.S.

Honorary Local Secretaries—H. E. ARMSTRONG and J. H. AMOS.

GLASGOW, 1883.

President.—PROF. G. M. HUMPHRY, M.D., F.R.S.

Presidents of Sections.

Section I.—Prof. W. T. Gairdner, M.D., LL.D.
„ II.—Prof. T. Roger Smith. F.R.I.B.A.
„ III.—R. Angus Smith, Ph.D., F.C.S.

Honorary Local Secretaries—J. B. Russell, M.D., and James Sellars.

DUBLIN, 1884.

President.—SIR ROBERT RAWLINSON, C.B.

Presidents of Sections.

Section I.—T. W. Grimshaw, M.A., M.D.
„ II.—C. P. Cotton, M.Inst.C.E.
„ III.—Charles A. Cameron, F.R.C.S.I.

Honorary Local Secretaries—John Beveridge, Charles A. Cameron, M.D., J. J. Diggles La Touche, M.A., Thomas A Drew, R.H.A., and William R. Maguire, F.R.Met.Soc.

LEICESTER, 1885.

President.—PROF. F. DE CHAUMONT, M.D., F.R.S.

Presidents of Sections.

Section I.—Arthur Ransome, M.A., M.D., F.R.S.
„ II.—Percival Gordon Smith, F.R.I.B.A.
„ III.—William Marcet, M.D., F.R.Met.Soc., F.C.S. F.R.S.

Honorary Local Secretaries—W. E. Buck, M.A., M.D., and A. H. Paget, A.R.I.B.A.

YORK, 1886.

President.—SIR SPENCER WELLS, Bart.

Presidents of Sections.

Section I.—Prof. F. de Chaumont, M.D., F.R.S.
„ II.—Baldwin Latham, M.Inst.C.E., F.R.Met.Soc.
„ III.—William Whitaker, B.A., F.G.S.

Honorary Local Secretary—S. W. North, M.R.C.S.

BOLTON, 1887.

President.—RIGHT HON. LORD BASING, F.R.S.

Presidents of Sections.

Section I.—Prof. J. Russell Reynolds, M.D., F.R.S.
„ II.—Prof. T. Hayter Lewis, F.S.A., F.R.I.B.A.
„ III.—Prof. A. Dupré, PH.D., F.I.C., F.C.S., F.R.S.

Conference of M.O.H.—Prof. W. H. Corfield, M.A., M.D.

Honorary Local Secretaries—R. G. Hinnell, E. Sergeant, L.R.C.P., M.R.C.S., and Marshall Robinson.

WORCESTER, 1889.

President.—G. W. HASTINGS, M.P., J.P.

Presidents of Sections.

Section I.—George Wilson, M.A., M.D.
„ II.—Henry J. Marten, M.Inst.C.E.
„ III.—J. W. Tripe, M.D., F.R.C.P. F.R.Met.Soc.

Conference of M.O.H.—Prof. W. H. Corfield, M.A., M.D.

Honorary Local Secretaries—W. Strange, M.D., and Horace Swete, M.D.

BRIGHTON, 1890.

President.—SIR THOMAS CRAWFORD, K.C.B., M.D.

Presidents of Sections.

Section I.—G. Vivian Poore, M.D., F.R.C.P.
„ II.—Prof. T. Roger Smith, F.R.I.B.A.
„ III.—William Topley, F.R.S., F.G.S.

Conference of M.O.H.—Arthur Newsholme, M.D., D.P.H.

Conference of Inspectors of Nuisances—Alfred Carpenter, M.D., M.R.C.P., D.P.H.

Honorary Local Secretary—A. Newsholme, M.D.

PORTSMOUTH, 1892.

President.—SIR CHARLES CAMERON, M.D., F.R.C.S.I., D.P.H.

Presidents of Sections.

Section I.—Prof. J. Lane Notter, M.D.
„ II.—James Lemon, M.Inst.C.E., F.R.I.B.A.
„ III.—W. J. Russell, Ph.D., F.R.S.

Conference of Naval and Military Hygienists—Inspector-General J. D. Macdonald, M.D., F.R.S.

Conference of Medical Officers of Health—Prof. C. Kelly, M.D.

Conference of Municipal and County Engineers—H. Percy Boulnois, M.Inst.C.E.

Conference of Sanitary Inspectors—Prof. A. Wynter Blyth.

Conference on Domestic Hygiene—Lady Douglas Galton.

Honorary Local Secretaries—Alexander Hellard and B. H. Mumby, M.D., D.P.H.

LIVERPOOL, 1894.

President.—SIR FRANCIS SHARP POWELL, Bart., M.P.

Presidents of Sections.

Section I.—E. Klein, M.D., F.R.S.
„ II.—G. F. Deacon, M.Inst.C.E.
„ III.—Thomas Stevenson, M.D., F.R.C.P.

Conference of Mercantile Marine—Sir W. B. Forwood.

Conference of Medical Officers of Health—Charles E. Paget, M.R.C.S., M.O.H. Salford.

Conference of Municipal and County Engineers—A. M. Fowler, M.Inst.C.E.

Conference of Sanitary Inspectors—Francis Vacher, F.R.C.S.

Conference of Ladies on Domestic Hygiene—The Lady Mayoress of Liverpool.

Honorary Local Secretaries—H. Percy Boulnois, M.Inst.C.E., and E. W. Hope, M.D.

Volume XV.—Part I.] [April, 1894.

JOURNAL

OF

THE SANITARY INSTITUTE.

INTRODUCTION.

The Council of The Sanitary Institute have decided to publish a Journal, which will in the first instance be issued quarterly, in place of the annual volume of Transactions. The object of this alteration is to circulate to the members at an early date the papers read at the various meetings of the Institute, to afford an opportunity for recording information of general sanitary interest, and to keeping the members more closely in touch with the work that is being carried on.

As this is a new development, it is appropriate that the first number of the Journal should contain a short epitome of the history of the growth of the Institute.

When the Public Health Act of 1875 came into force, the increasing importance attached to Sanitary Science, and the recognized position it was assuming in the public mind, fully justified the formation of a Society devoted *exclusively* to the advancement of all subjects bearing upon Public Health. In furtherance of this object, a meeting was held at St. James' Hall on 13th July, 1876, at which His Grace the Duke of Northumberland presided, when it was unanimously resolved—

> 'That in the opinion of this meeting the Sanitary condition of this country is still very unsatisfactory and that further legislation is necessary with a view to its improvement; and that for the purpose of collecting and imparting information upon all matters connected with the subject of "Public Health," a Society be now formed to be styled "The Sanitary Institute of Great Britain."'

A Committee was appointed to carry out the resolution, and the Society opened offices in Spring Gardens, W.

One of the first steps taken by the Institute was to establish examinations for Local Surveyors and Inspectors of Nuisances, as the Council felt it to be essential that the officers who had to carry out many of the provisions of the Public Health Acts should be competent for the duties they had to perform. The first examination was held in October, 1877, and there were eight candidates.

In order to spread the advantages of the Institute throughout the country the Council arranged to hold annual Congresses in provincial towns so as to bring together those interested in sanitary science to read papers and discuss questions affecting the Public Health. The first Congress was held at Leamington in October, 1877, and an Exhibition of sanitary apparatus and appliances was arranged in connection with it. Judges were appointed to examine the exhibits and medals and certificates were awarded.

In the year 1879 the constitution of the Institute was revised, and two new classes, Fellows, and Associates, were originated—at the close of that year the Institute numbered 64 Fellows, 241 Members, 3 Associates, and 29 Subscribers.

During 1880 many of the leading sanitarians abroad joined the Institute as Hon. Foreign Associates; this grade is now represented by the Hon. Fellows. The first volume of the Transactions of the Institute was published during the year, and in July the offices were removed to Conduit Street, W.

Up to this time the Institute had been continuing periodically its Examinations, Provincial Congresses and Exhibitions, and holding an Annual and also an Anniversary Meeting in London, at which Addresses were given; but in order further to aid in the diffusion of Sanitary knowledge, it was decided to hold Ordinary Meetings for the reading and discussion of papers. The first meeting was held in February, 1881, when a paper was read by Mr. W. H. Michael, Q.C., F.C.S., upon "The Law in Relation to Sanitary Progress."* The discussion on this subject occupied two evenings.

A sum of £200 had been placed in the hands of the Council by the Rev. E. Wyatt-Edgell, to be offered as a prize for an Essay on "The Range of Hereditary Tendencies in Health and Disease." The adjudicators appointed were Dr. William Farr and Dr. Benjamin W.

---

* Transactions, Vol. III., page 3, Appendix.

Richardson, and the prize was awarded, in December, 1881, to Mr. George Gaskoin, M.R.C.S.*

In the autumn of 1883 the offices of the Institute were removed to the premises it now occupies in Margaret Street, W., which had been acquired in the previous year by the Parkes Museum.

The Parkes Museum of Hygiene was Instituted in the same year as the Sanitary Institute of Great Britain (1876) as a permanent memorial of Dr. Edmund Alexander Parkes, the first Professor of Hygiene at Netley. The Museum was originally established at University College, where some galleries were placed at the disposal of the Committee for the exhibition of hygienic and sanitary appliances.

In 1881 the Council of The Parkes Museum organised and carried out the International Medical and Sanitary Exhibition at South Kensington, under the presidency of H.R.H. the Duke of Edinburgh.

In June, 1882, the Museum was made into an incorporated Society, under the Patronage of Her Majesty the Queen, and H.R.H. the Duke of Albany accepted the Presidentship. After the incorporation, the galleries at University College were required for other purposes, and the present premises in Margaret Street were obtained, very considerable alterations and improvements being made to adapt them for the purposes of the Museum. The Museum was re-opened in its new premises by the Duke of Albany in May, 1883. When the Sanitary Institute of Great Britain became the tenant of part of the premises in the autumn of that year the two Societies were kept distinct as regards their government and finances, but the public work undertaken was so arranged as to be in harmony; the future developments can therefore be referred to without specifying in each case by which Society they were instigated.

In 1884 the Public Health writings of Dr. William Farr were collected and published, so as to render these valuable writings, scattered through a number of Blue Books, more accessible to to students of Public Health. The International Health Exhibition was held at South Kensington during this year, and the Institute, by invitation of the Executive Council, assisted in arranging conferences at the Exhibition.† After the close of the Exhibition the Executive Council presented to the Parkes Museum a large number of books which had been collected. These formed an important addition to the rapidly growing Library of the Museum.

---

* An abstract of the Essay is given in the Transactions, Vol. III., page 100, Appendix.

† A record of these Conferences appears in the Health Exhibition Literature, Vol. VIII., p. 3.

The expense of keeping up the Parkes Museum was in the early years partly met by donations from the Corporation of London and from the City Companies, and in February, 1885, a public meeting was held at the Mansion House at which £1,000 was subscribed for the Museum, and the Council were enabled to purchase the lease of the building.

In the summer of the same year an Exhibition of Domestic Gas Appliances was held in the Museum.

Ten years after the formation of the Institute, that is, during 1886, the work developed rapidly. The examinations, which by careful and persevering organization had been slowly but surely gaining in public estimation, became popular; and Sanitary Authorities began to recognise the advantage that these examinations afforded in guiding them in the selection of Sanitary Officials. The number of candidates in 1886, viz., 124, was nearly double the number in the previous year.

The Examinations revealed the fact that Candidates for appointment as Sanitary Officers had considerable difficulty in obtaining knowledge of the principles of sanitation, the Council therefore established systematic courses of instruction suitable for these officers. The large attendance of Students at the first course, held in April, 1886, showed that this development of teaching work was much appreciated.

At the Autumn Congress (held at York) a Conference of Medical Officers of Health was added to the meetings for the purpose of bringing under discussion technical questions relating to State Medicine and Public Health Administration.

In 1887 the Institute, in conjunction with the Society of Medical Officers of Health, invited the International Congress of Hygiene and Demography to meet in London in 1889 but the meeting was eventually postponed until two years later. The writings and Public Health Reports of Dr. John Simon were collected and published in two volumes by the Institute. During the year a series of practical sanitary demonstrations for medical men was given in the Museum, the attendance at each demonstration was about 100.

Lectures on Domestic Hygiene for the purpose of instructing ladies in matters relating to household sanitation, were arranged in the

Museum, with the assistance of the National Health Society, in Lent, 1888. H.R.H. The Duchess of Albany was much interested in this branch of the work and became Patroness during the year. Early in the year the Trustees of the Berridge Estate apportioned £1000 towards the support of the Parkes Museum.

In August, The Sanitary Institute of Great Britain, and the Parkes Museum, which had been working together for five years, were amalgamated and re-incorporated under the title of The Sanitary Institute.

In 1889 a Committee was appointed by the Council for the purpose of watching and reporting to them upon any sanitary legislation brought before Parliament.

The Examinations of the Institute which had hitherto been held in London only, were, in 1890, extended to the provinces so as to make them more accessible to candidates living at a distance. The first provincial Examination was held at Manchester in December.

In the following year the Training Lectures for Sanitary Officers were also extended to the provinces, and arranged in conjunction with the County Councils; and in the Public Health (London) Act which was passed this year, the Institute obtained the insertion of a clause requiring all Sanitary Inspectors appointed after the 1st January, 1895, to hold a certificate of qualification.

The International Congress of Hygiene and Demography was held in London in August, 1891, and the members were received during the meeting at the Parkes Museum, which was thoroughly re-arranged and a printed catalogue prepared, the funds for the purpose having been provided by a liberal donation of £250 from Mr. Rogers Field. After the close of the Congress its Executive Committee voted £160 to the Institute towards the cost of preparing a catalogue of the Library.

During the sixteen years that Exhibitions had been held by the Institute, a uniform system of judging the exhibits had been organized, and in 1892 an illustrated and classified list of all the exhibits to which awards had been made since the incorporation of the Institute was published.*

In the same year arrangements were made for adding practical demonstrations to the courses of lectures for Sanitary Officers, and visits for the Students were arranged to sewage works, water works, trade premises, and other places that would be instructive from a sanitary point of view.

---

* This list, revised to the end of 1893, is given in the Transactions, Vol. XIV.

In 1893 these practical demonstrations were considerably extended and more elaborately organized. A first course of Lectures on the Sanitation of Industries and Occupations was held, and various experimental investigations were carried out. A record of these will be found in the Annual Report on page 53.

The several branches and developments of educational sanitary work referred to in this chronological epitome have nearly all been continued periodically, and the lectures and meetings have been extended over England and into Scotland and Ireland. A map showing the different centres visited is given in Vol. XIV. of the Transactions, page 253, and also a list of the meetings.

The many branches of work now carried on have been steadily growing since they were first started, and the Annual Report for 1893 records their development up to the present time.

E. White Wallis,
Secretary.

The Sanitary Institute,
April 2nd, 1894.

THE ETIOLOGY, SPREAD AND PREVENTION OF DIPHTHERIA.

By R. Thorne Thorne, C.B., F.R.S.

Sessional Meeting, January 10th, 1894.

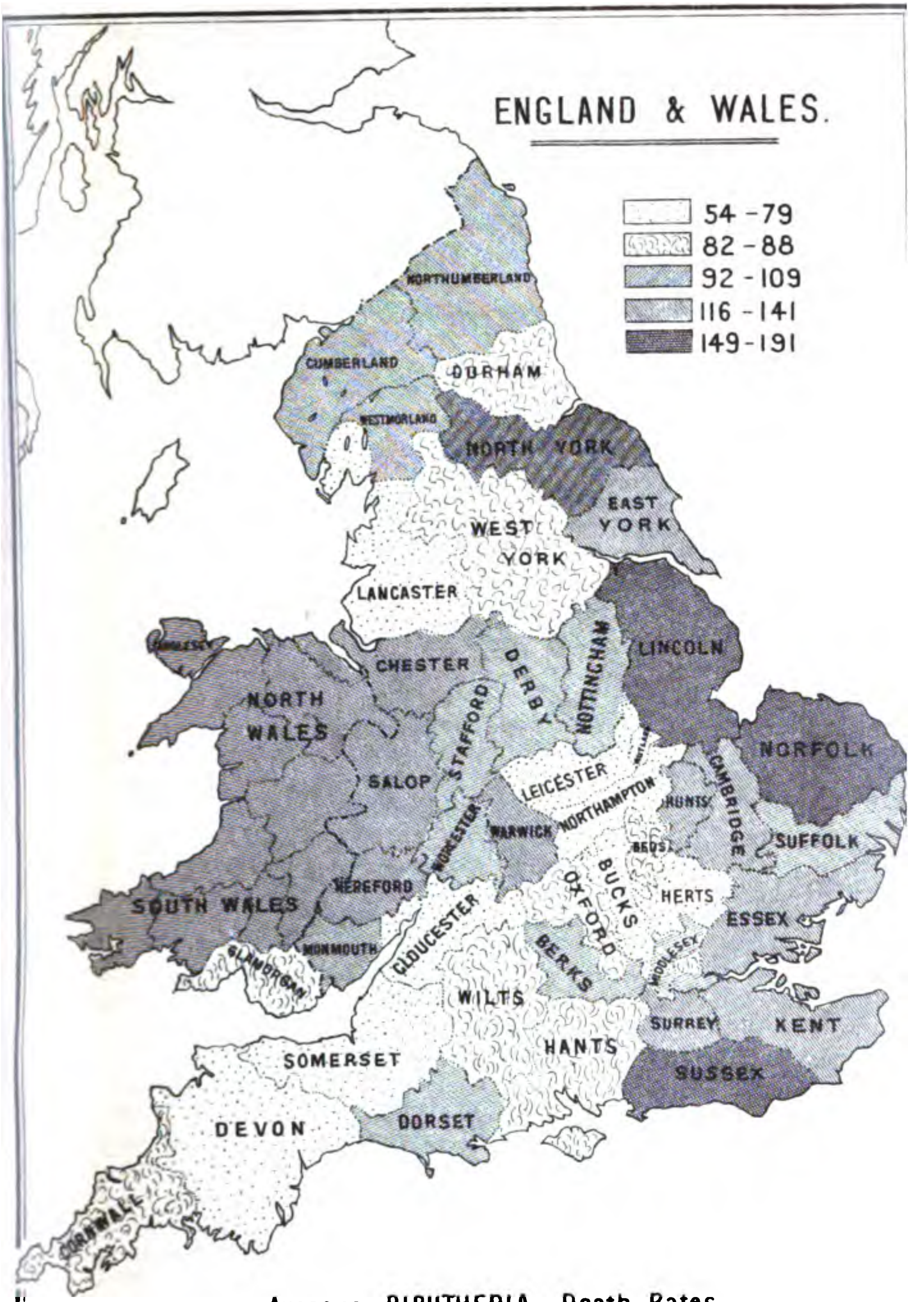
The first point to which I would advert is the distribution of diphtheria throughout the kingdom. If you look at this map which was prepared by Dr. Longstaff you will see that during the twenty-six years, 1855-80*, the incidence of the disease in various parts of the country is shown by degrees of shading. Taking 100 as representing the mean death-rate, you will note that where the shading is deepest the incidence of the disease has been the greatest, namely, at a rate varying from 150 to 190 per hundred thousand of the population. Where the shading is less deep the rate falls as low as from 50 to 80 per hundred thousand. The darkly shaded portion of the map lies in the main down the eastern coast of England and the next large patch of dark shading covers the principality of Wales. During the long period covered by this map most of the midland counties have practically had immunity from the disease, a fact which is important in view of the consideration of the question of the distribution of diphtheria in rural and urban centres respectively. The greater part of Wales, North Yorks, Lincoln, Norfolk, and Sussex, &c., may be classed as rural, and up to a certain date diphtheria was essentially a rural disease. But the distribution referred to favours the view that the occurrence of diphtheria is also favoured by cold and wet. You all know what the eastern coast is. It is exposed in the first instance to the wet from the North Sea, the East coast of England being also one of the coldest parts of the country. Wales on the other hand comprises both high lands and low-lying valleys. The latter, at least, are certainly damp, and cold prevails in the higher parts, but in Wales it is probably more the damp than the cold that encourages diphtheria. One thing is certain, that these two parts of the kingdom are markedly exposed to cold and damp.

---

* Corresponding dates for 1881-90 will not be available until after the issue of the decennial report of the Registrar-General for that period.

The comparative absence of diphtheria down the centre of England during the period referred to is the more remarkable seeing that the area comprises the basins of several of our greatest rivers where there is necessarily much moisture. The area of comparative immunity includes much of the Thames and the Severn basins, yet in spite of this these regions have rejoiced in a certain degree of freedom from the ravages of diphtheria. What the precise reason of this may be I do not know, but my conviction is that running water is a very different thing in as far as disease production is concerned from stagnant moisture, due to wetness of the soil, especially when permanent. We have several allusions in the Bible indicating that certain advantages attach to running waters—living waters as they are called—one is referred to as having health giving properties which the other does not possess.

Now diphtheria has considerably increased since it was first recognised in this kingdom, about 1845, when it was set down as having been imported from France, under the name of the Boulogne sore throat. Its first diffusion was mainly in rural areas. It spread mostly in the hamlets and villages and the sparsely populated districts. Then, as pointed out by Dr. Longstaff, there came a change in the incidence of the disease, and at the present moment we find that diphtheria is prevailing widely in many of our large urban communities, and in those great centres of population which were originally so free from the disease. There is, apparently, still an excess in the rural districts on the population as a whole but a change has come to pass in virtue of which the cities which were formerly almost exempt from the disease, are now suffering in a steadily increasing ratio, and diphtheria bids fair to become, as it never yet has been, one of the diseases of urban centres. This is a very serious state of affairs. During the last few weeks we have had a very exceptional amount of diphtheria in London. The Registrar-General's returns for a series of weeks show the deaths from diphtheria to have ranged from 80 to 90, and have even exceeded 100 in a single week. Indeed whereas the mean annual number of diphtheria deaths in London, during the fourth quarter of the three years 1889—1891 was 436, they reached no less than 1,089 in the fourth quarter, 1893. Such a thing has never before happened in the history of London since the disease made its appearance in the metropolis. The disease has now abated to some extent and this fact enables me to point out that diphtheria has a certain seasonal incidence. The season commences about the middle of September and goes on to the end of November. It decreases during December and continues to do so until March or April, when there is



Average DIPHTHERIA Death Rates
Twenty six years 1855 80
(ENGLAND & WALES taken as 100)

another elevation though much less in amount, the so called spring incidence. There is less diphtheria during the summer than at any time of the year.

Age affects the deaths in a very remarkable manner, as is shown by the Registrar-General's reports. Taking the proportion of deaths per 100,000, the deaths at different ages under 10, vary from 34 to 70. The moment you pass 15 years of age a change comes, and after 25 years, instead of rates reaching 43, 70, 64, and 70 respectively, they drop to 2, 2, 1, 2, and so on. Indeed after 25 years of age, diphtheria is a disease which is very little fatal in this country. And more than this, the deaths from diphtheria over that age occur to an important extent among those who are brought into contact with the sick, such as nurses, mothers, and medical men. The greatest age incidence of the disease, is between 3 and 10 years of age.

Sex too appears to have some slight influence in determining a liability to the disease though it is not well marked. We find that more females die from the disease than males, but I have thought that this arises mainly from the fact that females are more exposed to infection than males. Little girls, when they are sick, are not nursed by little boys, but little boys are often nursed by little girls, and this care for the sick by females holds good in adult life. Men do not usually nurse women suffering from diphtheria whereas males thus affected are usually nursed by women. A fallacy therefore underlies the figures bearing on the incidence of the disease as it affects the sexes, in so far as the mere influence of sex is concerned.

The effect of unfavourable sanitary surroundings in favouring outbreaks of the disease is another very important point. I have expressed an opinion on this point which is by no means universally received though the matter has been discussed at great length in the columns of the medical press by various well-known authorities. Some observers think with me that the influence of unsanitary surroundings on diphtheria has been greatly exaggerated, others hold that too much importance cannot be attached to unsanitary conditions as regards its causation. One eminent medical man was heard to remark that he had never gone over a house in which a case of diphtheria had occurred without finding some defect in the drains or sanitary arrangements, but I think I could guarantee not to visit many houses, quite apart from diphtheria, that did not present defects of some sort. I wish it to be clearly understood however that I have not taken up a position antagonistic to the view that the sanitary condition of a dwelling may have an influence on the disease, but any such influence is certainly overwhelmed by other conditions.

To make the position more comprehensible let me point to some facts concerning the mortality of typhoid fever both in the country generally as well as in London and in some of our large towns. Typhoid fever is essentially a disease associated with bad sanitary circumstances, and it responds more than any other disease to improvements in sanitary arrangements. The saving of life in this country owing to the diminution in the enteric fever death rate, has gone hand in hand with the improvements in sanitary legislation. England is the country in the world which has purchased comparative immunity from typhoid fever by the adoption of costly sanitary improvements, and I hope we may continue to preserve aud merit the palm in this respect. Early in the seventies the death-rate from enteric fever was practically about 0·38 per 1,000. It has gradually fallen to 0·31, then to 0·26, then to 0·23, then still further to 0·17 and 0·18, where it now stands. This means a saving of many thousands of lives annually, and the general mortality has followed the same lines, namely from 22·6 to about 18·0 per 1,000. The same decline has taken place in London till now when the enteric fever rate varies between 0·12 and 0·15 per 1,000 per annum, as opposed to 0·27 in 1871. This period of twenty years, I need hardly remind you, has been characterised by enormous progress in sanitary administration. If therefore diphtheria is due to faulty sanitary conditions we ought at least to be wiping it out to some extent, whereas we find that on the contrary it is going up by leaps and bounds. In 1872-73 the diphtheria mortality ranged from 0·9 to 0·11 per 1,000 in England, while in 1890 it was 0·18, that is to say about double. In London it began by killing from 0·8 to 0·10 per 1,000, then it rose to 0·14, next 0·17, then to 0·23, and finally we have it ranging from 0·33 to 0·39, and it has even been higher than this during the last two years. In fact the diphtheria death-rate has nearly trebled, and this during the very period that sanitary circumstances have been undergoing unexampled improvement. I do not say that sanitary conditions have nothing to do with the production of the disease but those who contend for the overwhelming influence of these conditions, should at least note that coincidently with our sanitary improvements diphtheria has doubled and even trebled as a cause of death amongst us.

I was asked before a Royal Commission not long since as to the influence of water in spreading the disease. I was told that one eminent physician had been to a house where diphtheria had broken out; he had found something wrong in the well, and my questioner seemed perfectly content to regard this coincidence as revealing cause and effect.

Annual Mortality per 1,000 Persons living.

YEARS.	England and Wales.		London.		Twenty-eight Large Towns.	
	Enteric Fever.	Diphtheria.	Enteric Fever.	Diphtheria.	Enteric Fever.	Diphtheria.
1871	0·37	0·11	0·27	0·10		
1872	0·38	0·09	0·24	0·08		
1873	0·38	0·11	0·27	0·09		
1874	0·37	0·15	0·26	0·12		
1875	0·37	0·14	0·23	0·17		
1876	0·31	0·13	0·22	0·11		
1877	0·28	0·11	0·25	0·08		
1878	0·31	0·14	0·28	0·15		
1879	0·23	0·12	0·23	0·15		
1880	0·26	0·11	0·19	0·14		
1881	0·21	0·12	0·25	0·17		
1882	0·23	0·15	0·25	0·22	0·37	0·16
1883	0·23	0·16	0·24	0·24	0·35	0·16
1884	0·23	0·18	0·23	0·24	0·29	0·17
1885	0·17	0·16	0·15	0·22	0·20	0·17
1886	0·18	0·15	0·15	0·20	0·23	0·16
1887	0·18	0·16	0·14	0·23	0·22	0·18
1888	0·17	0·17	0·16	0·30	0·20	0·21
1889	0·18	0·18	0·12	0·39	0·20	0·26
1890	0·18	0·18	0·15	0·33	0·19	0·24
1871—90	0·26	0·14	0·21	0·19	—	—

Now we have been working at the Local Government Board for twenty years on the subject of diphtheria, and in no single instance has any medical inspector been able to identify water as the probable cause of diphtheria. Bad water, of course, may prove harmful to individuals, by lowering their standard of health, and so perhaps predispose them to any malady that may be about, but I am confident that there is no direct relation between polluted water and diphtheria.

As a matter of fact, the diphtheria organism finds it very difficult to live in water. It can apparently only maintain existence in very polluted water, but average water is to a large extent destructive to its vitality.

Putting water infection on one side, much more interest attaches to the possible influence of imperfect drains and sewers. And here difficulty arises. The period over which our statistics extend is the period during which our sewerage system has been mended and amended and improved to a most important extent. Millions sterling have been spent in improving that system; yet diphtheria has not diminished, on the contrary, it has gone on increasing. Again, it has been especially in our large towns that these improvements in sewerage have taken place and have been perfected, yet early in the seventies there was not much diphtheria in our towns. It is since these improvements have taken place that diphtheria has made its appearance in our cities and has carried everything before it. It seems, therefore, that there can be no very direct connection between bad sewerage and diphtheria.

Diphtheria is essentially an infectious disease. The emanations from the throat and mouth are intensely infectious. By expectoration and otherwise the poison may get into the sewers and cesspools, and in that way I do not say these conduits, &c., may never be contaminated by diphtheria, and that diphtheria may not be caused by emanations from diphtheria-infected drains. In the same way soil may become contaminated by sewage, perhaps infected with diphtheria escaping from defective drains, sewers, and cesspools. Indeed, I am convinced that there is some relation between the influence of soil and diphtheria, and that this influence is dependent on movements in the level of the subsoil water. When the water level rises, the diphtheritic and other organisms which may happen to be in contaminated soil are carried up, and the polluted air of the soil is expelled; and so the diphtheria infection may also be expelled and inhaled. I admit the possibility of such a sequence of events; but this does not affect the major question as to the relation of Sanitary circumstances to diphtheria.

But there is something further. We hear of a "drain sore throat." I do not know exactly how to define this ailment, but I am certain that people who inhale effluvia from drains do get a form of sore throat, in much the same way as students in hospitals get what is called the hospital sore throat. There are thus here two ways in which foul or contaminated air may lead to sore throat. Now, I have a strong impression, though I might not be able to prove my contention, that diphtheria never attacks a healthy throat. I will not undertake to say what constitutes a healthy throat in this sense, it may be the mere question of the chemical reaction of the secretion in the fauces. But from the moment you get an inflamed or denuded sore throat, whether produced in the one or the other way, there seems nothing the diphtheria organism likes so much to fasten upon as upon such a surface. It may therefore be, not so much drain emanations that cause diphtheria, as that they prepare the soil for the development and multiplication of the specific organism of the disease.

I am credited with having started a diphtheria theory of my own. In some investigations which I made I have found circumstances which I soon found had been observed by others. Take for example the Welsh valleys. There we find cottages erected upon the slope of a hill, built right into the hill sides, so that the walls are always wet, the floors are mud, covered with porous brick or not, thus damp is ensured. During the cold weather these people suffer much from sore throats and if you look into their fauces you will almost always find traces of deep ulceration and other indications of past inflammation of the tonsils. The sore throat, an ordinary sore throat so far, is passed from one to the other, for all forms of sore throat are apparently infectious, and by-and-bye—as I myself have observed—the disease increases in intensity until it culminates in an outbreak of definite diphtheria. After eliminating sources of error the explanation that occurred to me in respect to these circumstances is that there was a progressive increase in the infectiveness of the organism producing the infectious sore throat. There is nothing, I think, irrational in such a view, although certain distinguished bacteriologists do not feel able to accept it. Some, indeed, hold that just as cats, dogs, and horses always breed truly producing cats, dogs, and horses, so the various micro-organisms ought also to breed true. To some extent and in respect of certain organisms this may be true. If you go to a house where there is measles you do not expect to catch whooping cough, nor scarlet fever where a patient is suffering from typhoid, but it seems to me that some of these infections are probably more stable than others and I am inclined to think that the diphtheria organism is among the unstable ones, and that it is capable of acquiring disease producing properties which it did not possess previously. This process I have termed the property of progressive infectiveness. We know that if you take wild plants from the heath and place them in a hot house under specially favourable circumstances of temperature, soil, &c., they will in a few generations develop properties very different from those they originally possessed, and later on if relegated once more to their native heath they gradually lose these properties and return to their original condition. If we apply this train of reasoning to the organism of diphtheria it will be seen how, under favourable conditions of environment and soil, it may develop properties which it did not possess in the first instance. Dr. Adams, of Maidstone, who has given special attention to the subject, records the observation that "again and again epidemics of diphtheria arise from a crowd of ordinary and apparently non-specific sore throats." Others have found the same thing.

There is another form of sanitary circumstances which presents more difficulty, viz.: manure nuisances. There does seem to be some perhaps nearer relationship between them and the production of diphtheria. Certain it is, by coincidence or otherwise, that outbreaks of diphtheria have in a very peculiar way occurred at places along the Thames where London manure is deposited, but it is quite possible that the manure itself—abounding in cast-off refuse—may have been the vehicle of transmission of the poison from antecedent cases.

Before dismissing the assumed tendency of the diphtheria organism to settle down upon any sore throat and there to develope, I may mention that a definite relationship has been alleged between scarlet fever and diphtheria. Now I cannot trace evidence of cases in which scarlet fever has followed diphtheria, while there are hundreds of instances in which the convalescent patient from scarlet fever has contracted diphtheria. This, I believe, is only another example of the tendency of the organism to attack sore throats generally. The scarlatinal throat affords to the diphtheria organism the gate of entry where it can fix itself and develop under favourable circumstances.

Diphtheria is certainly a disease specially prone to attack children between the ages of three and ten or twelve, but it is very difficult to determine for certain how far this is simply a question of age. The period of life in question is that when children go to school; and the question arises—is it the age, or the effect of school? I remember my attention being called to this question when inquiring into an outbreak in a village in Essex, which altogether attacked upwards of 1,400 persons spread out over a long time. There were 272 cases under three years of age, some of whom went to infant schools; but between three and twelve, the special age incidence for diphtheria, the number reached 928; and between twelve and fifteen years the number was 210. This points in itself to a special incidence affecting children between the age of three and twelve. But of course the majority of the children were at school at that age, and so I had to separate those who went to school from those who did not. I found that while among those between three and twelve years who were known to go to school, the proportion to total of children at that age was 9·5 per cent., whereas it was only 6·2 per cent. amongst those who did not go to school, and this although many of the latter contracted the disease from elder brothers and sisters at school. The question of the influence of schools has been worked out in detail by my friend Mr. Power, who stands foremost amongst etiologists of the day. He has succeeded in showing that not only is the incidence greater among those who go to school, but that, under certain circumstances, it is possible by aggregation of children in school to manufacture a diphtheria of special potency.

Mr. Power investigated this matter in one district in which it was possible to know every child and the movements of each child. The school was in working order, and taking the age incidence between three and twelve, he found that 16·6 per cent. of those attending school had diphtheria, but only 3·8 per cent. of those who did not go to school. While dealing with this point, I must remind you that children who contract diphtheria at school may easily carry the infection to others who remain at home, and that even this proportion of 3·8 per cent. may be in part explained as emanating from school. The schools were closed for many weeks, in order to try and get rid of the disease by eliminating all children who had sore throat. Then came the second period. The schools were re-opened and 4·8 per cent. contracted diphtheria amongst school attendants, whereas none of those who stayed at home caught the disease. Again the schools were closed and greater precautions were ordered, no child being allowed to return to school whose throat on examination was not quite sound. Then the schools were re-opened, and this time the proportion attained 7·1 per cent. among those who went to school, while only 2·5 per cent. of those who did not go were attacked. The schools were closed afresh and the Medical Officer of Health himself undertook to examine the children as to the condition of the throat, and the teachers were instructed to refuse every child who was at all unwell in the slightest degree. Nevertheless on the fourth re-opening 4·1 per cent of the school children were attacked with the disease, whilst none were attacked amongst non-school attendants; and this although between these periods there was not a single case of sore throat known to exist anywhere. These percentages, too, relate to children not living in infected houses; and on each occasion of school closure, disinfecting and cleansing of the school premises were resorted to. These events show with remarkable clearness the influence which school life exercises on the spread of diphtheria.

In what does this influence consist? First of all it brings together the most susceptible members of the community under circumstances which are peculiarly favourable to this kind of infection. The children are close to each other, and in saying or intoning their lessons they have facility for breathing into the faces and mouths of their neighbours. Consequently any child with a trace of diphtheria can easily infect other susceptible children. The Education Department requires so much floor space per child, but if you have ever been into an infants' school, for example, you will have observed that of the available floor space some two-thirds are often monopolised by the teacher, it being necessary to aggregate the children at one end of the room. The greater the want of ventilation, also, the greater the risk. Then, too, children of young age are very fond of passing on sweets from mouth to mouth and of drinking out of the same unwashed cup, thereby offering every opportunity for serial infection.

Aggregation under these circumstances recalls the reference to the hot-house plant. The children are brought together; they are aggregated in a sort of hot-house; there is often a want of due ventilation; there is overcrowding where they are aggregated, and in fact many of the circumstances that theoretically would tend to aggravate the virulence of the diphtheretic poison are present.

I am afraid the school attendance officers have, at times, been responsible for spreading the disease. They stimulate attendance without inquiring whether or not the child has been kept at home on account of sore throat.

This leads me to ask what has been going on in England during the last twenty years, in which diphtheria has been increasing? During this period education has made vast strides. It was most successful at first in rural districts where the country clergyman succeeded in getting every child into attending school. Indeed, I am afraid these clergymen have been, unknowingly, responsible for the spread of the disease; though I willingly recognise that their motives were in the interests of the children. It was years before a similar educational success was seen in London. But some change has evidently taken place in London and other great cities whereby diphtheria has been enabled to take a hold upon us, and this change, in my opinion, is the progress and perfection of compulsory education, acting, as I have said, by causing the aggregation of the most susceptible members of the community. Of course we cannot stop elementary education, but it may be possible to modify the circumstances which I have shown to be potent factors in spreading the disease.

The next influence in importance is, I consider, that of milk infection and as to this there may be less agreement. A large number of outbreaks of diphtheria have been distinctly traced to milk, and many of the outbreaks in former years, the origin of which is obscure and difficult to explain, would have been explained had this method of infection then been recognised. The milk may be infected by reason of the presence in the dairy of a child or other person suffering from the disease, for if the germ falls upon the milk this affords it an excellent medium for its growth and development. I do not, however, think that this is often the cause of the diffusion of diphtheria.

A far more frequent cause in my opinion is the existence of a disease in the cow itself.

In inquiries into certain outbreaks it has been shown conclusively that the diphtheria followed particular "milk walks," that is to say the clientèle of particular dairymen. It has even been traced to particular sheds and finally to particular cows. It is true that a considerable number of the persons who drink the milk escape, but we have similar results whatever infection we deal with. It has, however, been noticed that children who were habitual milk consumers suffered the most, whereas, those who took little and that little either boiled or only in tea, &c., mainly escaped. Again, those who took cream suffered more than those who did not, an observation I had already made in respect of typhoid infection. I at first took this to be merely a mechanical effect, the oil globules in rising carrying upwards the organism. With regard to diphtheria, however, Mr. Power has shown that this is not the case. He finds that those who take fresh milk suffer less than those who take either skimmed milk or cream. And the point with him is the keeping of the milk. If you partake of an infected milk while it is yet fresh you only take a small dose of the poison because the organisms have not had time to multiply. If on the other hand you take milk that has been standing twenty-four hours they have had plenty of time to multiply and the dose of poison is proportionally greater. The lesson to be learned is to leave off drinking raw milk altogether, and so escape many diseases, diphtheria among the number. I believe we are almost the only nation addicted to using raw milk. Some tribes in India would no more think of drinking raw milk than of eating raw flesh, but how far they exhibit immunity from any special diseases, such as diphtheria or tuberculosis, I have no data to show.

The relationship of the lower animals to man in respect of infection is interesting from every point of view. Many of the lower animals have been suspected of constituting a danger in regard to diphtheria; cats for instance. But the question has often arisen in individual cases whether it is the cat that gives diphtheria to the child or the child to the cat. One thing is certain, viz., that the cat can be inoculated with human diphtheria and suffers from definite well marked and specific symptoms typical of this disease, and that the diphtheria organism can be found in the cat. Although I have little doubt as to the possibility of a diphtheria cat passing on the malady to the child, I doubt if much of our current diphtheria is contracted in this way. Then there is the cow. Whenever these milk outbreaks have been traced back to the individual shed there has nearly always been the possibility of finding cows suffering from some disease. Now some of the diseases of cows are very vague. There is so much that is unknown with regard to udder-disease associated with vesicles and pustules that one is touching upon difficult ground. The fact remains that one frequently finds that the cows to whose milk diphtheria has relation, have been suffering from disease associated with a rise of temperature and vesicles and pustules upon the udder, the cow being evidently ill. An objection frequently urged in such cases is that there was someone on the farm who was suffering from diphtheria and who might have contaminated the milk. But there is nothing extraordinary in some of the persons on the farm being affected, it would indeed be extraordinary if people on such a farm and who equally use the milk were not also subjects of the infection.

If you take diphtheritic matter from the child and inoculate a milch cow—it should be a milch cow—Dr. Klein has found that one gets a disease which he says he is absolutely unable to distinguish from that found in the sheds to which the milk has been traced. On the fifth day vesicles, pustules, and ulceration make their appearance, and material from the vesicles contains the typical organism as found in the human subject. He inoculated a cat with it and the cat developed diphtheria. Then some of the milk from this diseased cow was accidentally given to a cat, and the cat developed typical diphtheria. These facts alone, I think, are quite sufficient to show that there is a field demanding further investigation.

I have a firm impression that a large number, if indeed not the great majority, of our specific diseases come to us through the lower animals, or have come from them. I have just said that diphtheria is not a stable disease as some others are, but for this very reason I think we ought to lose no time in taking the necessary measures to diminish its incidence before it has had time to become stable, and we must not allow ourselves to be deterred from making the necessary enquiries and from taking the necessary measures in a matter of this importance on the plea that they may interfere with somebody's trade.

Coming next to prevention, we must bear in mind that diphtheria is essentially an infectious disease, and the most frequent source of the disease in this country is certainly infection from one person to another. Hence it is evidently necessary to isolate patients, and in most cases this can only be done by isolation in hospital. Those who have visited diphtheria hospitals on a large scale will admit that the system is not altogether satisfactory, the mortality in them is very high, and we cannot say precisely why. Probably only the severer cases reach the hospital. But, apart from this, we must remember that the principle of aggregating infectious diseases, or any diseases, is altogether wrong, and that it is the advantages attendant on the care of patients in hospitals that compensates for incurring an enhanced risk. Nevertheless we must never lose sight of the fact that hospital construction entails one great evil—aggregation of the sick.

What we require, therefore, is a large amount of air space; but that means money, in construction, land, management, &c. What we want most is linear space, compared with which mere cubical measurement is unimportant. A hospital may be as lofty as you please, but if the patients are packed closely together on the floor, the movement of air about them will be deficient and the place unwholesome. A large amount of wall space is the principal way to avoid the evils of aggregation, for it is this which alone adequately prevents one sick person from inhaling the exhalations of another.

Where sore throat ends and diphtheria begins I cannot say, but where diphtheria prevails no child who is suffering from any form of sore throat should be allowed at school, nor even anyone from the house in which that child resides. In regard to the closing of schools, the Education Department make some allowance when the school is closed by order of the Medical Officer of Health, so that the grant may not be lost, on the ground of diminished attendance; but then it is not always desirable or necessary to close the schools. Let us take the example of a central village in which the school is situated, with several outlying hamlets A, B, C, and D. An outbreak of diphtheria may occur at C. Of course no children from that hamlet ought to be allowed at school, but it would be a mistake to close the school altogether, because then the other children would have time and opportunity for frequenting C and catching the disease. While they are in school, at any rate, they are free from this particular source of infection. Unfortunately, there is at present no financial provision for this contingency, and the school suffers in the grant by reason of the non-attendance of the scholars from C, whilst the school itself remains open.

I need not here go into the details of disinfection and the destruction of infected articles. You must all be familiar with such elementary requirements. There are plenty of instances to prove that the disease can be conveyed by clothing. I remember the case of a woman living in a country place who lost her child from diphtheria, and, after its death, she gave the clothes to a friend from a distance. Within a few days the children of this friend developed the disease and died.

Disinfection must take account of clothing as well as of premises.

Then you must boil or otherwise cook all your milk and your milk foods. Children should never be allowed to come into contact with domestic animals which are ill. Build your house on good foundations, drain the soil properly and keep trees at a proper distance. Near to a house they keep out sunlight, and render a house damp and unwholesome.

Sir THOMAS CRAWFORD, in proposing a vote of thanks to the lecturer, confirmed what he had said as to the habits in India with respect to the consumption of raw milk. He said he had always viewed the construction of large hospitals for fevers, cholera, &c., as going in a wrong direction, and he urged the construction of small hospitals with plenty of space.

Sir DOUGLAS GALTON agreed with what had been said as to the defects of large hospitals, but he pointed out that the modern tendency was to construct hospitals which were in reality an agglomeration of small hospitals. He regretted that the principle of constructing these hospitals with more than one story had received recent approval. He added that special attention had been paid to wall space and floor space, nearly 200 feet of floor space being allowed per diphtheria patient.

THE SANITATION OF PLACES WHERE FOOD IS STORED AND PREPARED.

Bakehouses.

By F. J. Waldo, M.A., M.D. (Cantab.), D.P.H.,

Medical Officer of Health, St. George-the-Martyr, Southwark, Inner Temple, and Middle Temple.

Read at the Sessional Meeting, February 14th, 1894.

The subject upon which I have been invited to address you covers so much ground that it would be hopeless to attempt to deal with it exhaustively within the limits of time allotted to this paper. I, therefore, propose to confine my remarks more particularly to the consideration of the hygienic aspects of bakehouses. At the same time, it may be broadly stated that many of the objectionable features met with in ill-regulated bakehouses are reproduced in bad kitchens.

After a prolonged consideration of this question, I have been forced to the conclusion that there is urgent need throughout the United Kingdom for enquiry and reform. Under the present system, the health of the workman often suffers, and in some instances the public health is also endangered. To remedy these evils, I would suggest—(1) that inspection under existing statutes should be more systematic and complete; (2) that legislation is needed to extend the powers of local authorities to deal with all aspects of the bakehouse question. Further, I am of opinion that a proper scheme of legislative action could be best initiated by a Select Committee of the House of Commons.

Too little attention has, I think, been devoted in the past to the wholesomeness of places where food is stored and prepared. Most practical sanitarians will agree with me that this neglect is likely to entail consequences more or less serious upon the food consumer, and in a still greater degree upon the food producers.

Turning to that portion of the subject with which I propose to deal more particularly, namely, to the question of bakehouses, this attitude of general apathy is especially remarkable. In bread, we have to deal with an article of prime necessity; it is the staple and essential factor in all dietaries, and every citizen is directly concerned in matters affecting its cost, its purity, and its methods of production. These being the circumstances, it seems hardly credible that, on a moderate estimate, one-half of the bread supplied to Londoners is sent out from cellar bakeries, or, in other words, is manufactured in underground places which violate the first principles of sanitation. This estimate, it may be at once acknowledged, is only approximate, as it is impossible to obtain anything like a comprehensive statement of facts and figures. In my own district of St. George the Martyr, Southwark, I find that out of sixty-seven bakeries, twenty-three are situated altogether, and nine partially in basements; a proportion which is exceeded in other Metropolitan districts. In considering the source of the total output of bread, moreover, the fact must be taken into consideration that some of the above-ground bakeries carry on business on a very extensive scale. On the whole, however, I think we may take it as a fairly correct assumption that about one-half of the Londoners' daily bread is derived from underground bakeries.

According to the Census of 1891 there are no fewer than 18,029 bakers in London, and 84,158 in England and Wales.* These figures do not include the pastrycooks and confectioners, many of whom work underground, but whom I exclude as they are not directly concerned in the production of bread. The bakers, however, constitute a large and important class, and when we take into consideration the wives and children dependent on their exertions, it will be evident that our present discussion directly affects the interests of a large section of the industrial community.

The lot of the journeyman baker is neither a healthy nor an enviable one. From the nature of his occupation he is placed in an environment that saps his strength and too often makes him prematurely aged. His face is thin and pale, his shoulders are rounded, and his whole look is suggestive of chronic ill-health. Nor is this to be wondered at when we consider the fatiguing nature of his work, which is carried on through the night and far into the next day. He is exposed to damp and to great and sudden changes of temperature, and he habitually breathes an atmosphere which is charged with dust, with the fumes of coal, with the products of respiration, and not infrequently with actual sewage contamination. In consequence of the unhealthiness of the employment the young journeyman changes his occupation whenever he is able, and thus swells the mortality figure of some other trade. His place, however, is quickly filled up by a recruit from the country, or by an apprentice from Scotland or the West of England.

---

* Since the Census of 1881 the bakers have added 13,126 to their number.

Dr. Ogle's tables of comparative mortality of males between twenty-five and sixty-five years of age, founded upon the Death Registers of 1880-1-2, offer some suggestive figures. From them we learn that in one hundred different occupations bakers occupy the following relative positions: in suicide they come third, in alcoholism seventh, in liver disease eleventh, in diseases of the circulatory system eleventh, and in diseases of the nervous system twelfth. Many of these diseases may be traced to the abuse of alcohol, an evil habit which is doubtless fostered by the fatigue consequent upon the overwork, the long hours, the want of sleep, and the poisonous atmosphere to which the journeyman baker is exposed. It may be remarked that Dr. Ogle's tables do not confirm the high rate of mortality from consumption and diseases of the respiratory organs testified to by other authorities. This apparent anomaly is possibly explained by the fact that a small proportion only of the total number of bakers included in his tables are exposed to the bad environment met with in London. In short, his figures deal with the state of the trade generally, as apart from the Metropolis, and in this way they are diluted, so to speak, with the more favourable results obtained from provincial bakeries.

Among the diseases to which bakers are specially liable may be mentioned rheumatism, colds, erysipelas, and a form of eczema, due to the irritation of the flour, known as "bakers' itch." They are peculiarly liable to rupture; Malgaigne, indeed, states that their tendency to that affection is three times that of other trades. This observation is readily accounted for by the fact that the baker has to lift heavy sacks weighing 280 pounds. Another common affection of bakers is flat-foot, a deformity that produces a peculiar gait, and is also due to long standing, and the habitual lifting of heavy weights.

As to the hours of work, from personal enquiries among the journeymen I find that seventy-two hours' work weekly is a fair average in the better class trade, with Saturday evening and Sunday free. Nor is it easy to see how, with the present system of making bread by hand, this time could be materially shortened. In the poorer neighbourhoods, where what is known as a "cutting" business is conducted, the baker works from eighty-four to a hundred hours weekly, and, in addition, frequently bakes dinners up till half-past one o'clock on Sunday.

Perhaps the best way to form an idea of the realities of a cellar bakehouse will be to draw a picture of such a place, sketching in the details from facts which have come under my own observation.

First of all we enter a baker's shop from the street, and descending a trap door, climb down a steep ladder into the bakehouse. We then find ourselves in a cellar some twenty or thirty feet in length, and ten or twelve feet in breadth. It is, in fact, an ordinary basement cellar, six or seven feet high, and is lighted by gas jets. Its roof is unceiled, and between the boards covering the warped rafters are many cracks, which open directly into the shop above. A portion of its floor-space is occupied by a slightly-raised wooden platform, on which are ranged a number of sacks of flour. Along one of its sides are placed the kneading troughs, large wooden boxes, which are fixed immovably against the damp and whitewashed wall. The oven stands at one end of the bakehouse, away from the sacks of flour, and consists of a long, deep chamber built of unglazed bricks. Its furnace is fed with coal, a supply of which lies in a loose heap close by. In the darkest corner of this underground bakery stands a kind of open cupboard, in which a water-closet is placed.

In the cellar thus fitted up are carried on all the operations of mixing, kneading and baking the dough, in addition to which it often serves for storing the loaves of bread.

On descending the stairs, the visitor finds himself plunged into a hot and stifling atmosphere. Pursuing his investigations, he will find that the air is vitiated from many sources, for instance, there is the active contamination of the flaring gas-jets, while the furnace fills the place with sulphurous fumes, more especially when the journeyman economises fuel by closing the damper. The air is further charged with moisture and with other products derived directly from the baking of the bread. Sewer gas may enter through the drain openings in the floor, the more so as the grating traps are often worthless. It may enter, moreover, through a defective closet soil-pipe. Further pollution is caused by the ground air and damp which are sucked up into the heated cellar through the faulty flooring. But this is not all, for in low-lying districts there is the danger that in times of heavy rainfall the sewage may force its way through the drain-pipes into the bakehouse. It is easy to see that the introduction of a flood of sewage in this way may bring the germs of typhoid and other filth diseases into direct contact with the loaves of baked bread.

Ventilation, in any real sense of the term, is absent, and, indeed under the circumstances we have pictured, is impossible. An inlet grating usually exists at the level of the street, but as a rule it is kept carefully closed by the journeyman, who is morbidly susceptible to draughts. In most cases, again, there is another small inlet at the back of the cellar, but the second ventilator is almost invariably covered up by means of a sack. It will be seen therefore that not only is the air systematically poisoned from within, but also, that no provision is made for that constant renewal from without which is essential to health. We may safely assert that no man could habitually work in an atmosphere even approaching that which has been portrayed without sooner or later sustaining serious injury to his health.

Our description, however, has by no means exhausted the evils incident to a bad underground bakehouse. In many of these places the unhappy journeyman is actually shut up for twelve hours or more at a stretch, and during that period adds his quota to the general impurity. At times he smokes, or uses tobacco in the still more objectionable form of chewing. Now and then dogs and cats are found in the cellars. Other forms of animal life include rats, mice, black beetles, cockroaches, ants and spiders, the smaller insects often being present in almost incredible numbers. Then the moist and heated atmosphere is favourable to the rapid decay of vegetable matter, and this takes place in the scraps of dough and refuse flour which collect in the hollow sides of and beneath the kneading troughs. The same conditions act on the coal, and cause it to give off various injurious gases.

Bread, as everyone knows, is peculiarly liable to absorb moisture and gaseous substances. When stored in a badly arranged bakehouse, therefore, it can hardly escape deterioration. Moreover, when prepared under these conditions, it is liable to be injured at every step of its manufacture. The flour becomes damp, musty and sour, the "sponge" and dough contaminated by the sweating arms of the journeyman, while on all sides it is exposed to the risk of sewage and of other noxious emanations. Lastly, the water with which the flour is mixed is often obtained from the same cistern which supplies the water closet, a system which is nothing less than an open invitation for the entrance of sewage matter into an important and universally used article of food.

In London there are between thirty and forty "model bakeries," that is to say, places where baking is carried on in a cleanly and scientific way, amid wholesome surroundings. This number does not include the wholesale factories, of which there are several of large size. It will be sufficient here if I briefly lay down the principles which should guide the construction and management of a sanitary bakery.

First, the building itself should be specially built for the purpose, with strong walls and a plentiful supply of windows. Separate and lofty rooms should be provided for storing flour, for mixing and kneading the dough, for baking, and for storing the bread. The flour-loft should be placed at the top of the building, and all the sacks should be conveyed thither by means of a lift, so as to spare the workmen as much as possible from the laborious and dangerous work of hauling about heavy weights. The mixing and kneading room should be provided with movable iron troughs, the kneading as well as the mixing to be conducted by means of machinery wherever possible, in order to avoid the handling of dough or flour by the workmen. Then a special provision should be made for thoroughly cleansing the empty sacks before they are returned to the miller.

These various rooms should be light, airy and lofty, and be kept with the most scrupulous regard to cleanliness. Much will depend on the construction of the rooms. The walls, ceiling and floor of each room should be of smooth and non-absorbent material, such as glazed tiles for the walls and roof, and hard wood or tesselated pavement for the floor. The windows should reach to the ceiling, and be kept permanently open at the top. Additional ventilation could be provided by means of Tobin's tubes and other appliances, but in all cases it is imperative that all such apparatus should act automatically and be beyond the control of the workmen. As much daylight as possible should be admitted to every part of the building, and no part of the bakehouse must be below the ground level. Where artificial light is wanted, it would be best obtained from electric lamps. The water used for mixing the dough must be provided from a special and separate cistern, or better still, direct from the main. All sanitary conveniences, including wash-basins and baths, should be placed in a basement, or in some place quite apart from the main building.

The ovens themselves may be heated in various ways. Some of the most cleanly and convenient means are by gas or by wrought iron tubes containing super-heated steam. If coal or coke be used, it is important to insist that the furnace room be freely ventilated, and that on no account is the flue to be closed by a damper.

Let us glance briefly at the state of legislation with regard to bakehouses.

Before 1863 no special legislation existed. In that year, however, the Bakehouse Regulation Act was passed. The measure in question was introduced at a time when public attention had been pointedly drawn to the unhealthy conditions under which baking was carried on. The duty of enforcing this first Act of 1863 was imposed on the local authorities. As a result of the report of a Royal Commission on Factories and Workshops in 1876, the Factory and Workshop Act of 1878 became law, and at the same time the Bakehouse Act was repealed. For some unaccountable reason, and against the advice of the Commission, the regulation of bakehouses was transferred from the local authorities to the already overburdened factory inspectors, who numbered six only for the whole of London. In 1883, on the passing of The Factory and Workshop Amendment Act, the duties were re-transferred from the factory inspectors to the local authorities.

The present law regarding retail bakehouses, as far as London is concerned, is incorporated in Sections 26 and 27 of the Public Health (London) Act, 1891. The provisions of the Act of 1878 are contained in Sections 34, 35 and 81. These Sections repeated in Section 26 of the Public Health (London) Act, apply to such bakehouses only as are situated in any place that contains, according to the last published census, a population of more than 5,000 persons. Section 34 runs as follows: "Where a bakehouse is situate in any city, town, or place containing, according to the last published census for the time being, a population of more than 5,000 persons, all the inside walls of the rooms of such bakehouse and all the ceilings or tops of such rooms (whether such walls, ceilings, or tops be plastered or not) and all the passages and staircases of such bakehouse, shall either be painted with oil or varnished, or be limewashed, or be partly painted, or varnished and partly limewashed; where painted with oil or varnish there shall be three coats of oil or varnish, and the paint or varnish shall be renewed once at least in every seven years and shall be washed with hot water and soap once at least in every six months; where limewashed the limewashing shall be renewed once at least in every six months. A bakehouse in which there is any contravention of this Section shall be deemed not to be kept in conformity with this Act."

Section 35 of the 1878 Act states that a place on the same level with the bakehouse and forming part of the same building shall not be used as a sleeping place, unless it is constructed as follows, that is to say: "It must be effectually separated from the bakehouse by a partition extending from the floor to the ceiling, and unless there be an external glazed window of at least nine superficial feet in area, of which at least four-and-a-half superficial feet are made to open for ventilation." There is no apparent reason why the operation of this Section should have been confined to urban districts. Surely, in the interests of the sleeper or of the bread consumer—whether rustic or cockney—it is desirable that the Section should be of general application. Section 81 of the 1878 Act provides that if Section 34 be contravened the occupier of the bakehouse shall be liable to a fine not exceeding £10.

The sections of the Act of 1883 applicable to bakehouses, and repeated in Section 26 of the Public Health (Lond.) Act are Sections 15 and 16. Section 15 relates exclusively to places which were not let or occupied as bakehouses before the 1st of June, 1883. This Section provides that it shall not be lawful to let or to suffer to be occupied as a bakehouse, or to occupy as a bakehouse any such place, unless the following regulations are complied with: (1) No water closet, earth closet, privy, or ashpit, shall be within, or communicate directly with the bakehouse; (2) Any cistern for supplying water to the bakehouse shall be separate and distinct from any cistern for supplying water to a water closet; (3) No drain or pipe for carrying off fæcal or sewage matter shall have an opening within the bakehouse.

It is to be regretted that this section is not applicable to bakehouses let or occupied as such before, as well as after, the 1st of June, 1883.

Section 16 relates to all bakehouses whatever may be the date of their construction or first occupation. It provides that where a court of summary jurisdiction is satisfied on the prosecution of a Local Authority that any place used as a retail bakehouse is in such a state as to be, on sanitary grounds, unfit for use or occupation as a bakehouse, the occupier of the bakehouse shall be liable, on summary conviction, to a fine not exceeding forty shillings, and on a second or any subsequent conviction, not exceeding £5. The Court, in addition to, or instead of, inflicting such fine, have it in their power to order means to be adopted by the occupier within a time named in the order for the purpose of removing the ground of complaint, and may on application enlarge the time so named; but if after the time so originally named or enlarged by subsequent order, the order is not complied with, the occupier will be liable to a fine not exceeding £1, for every day that such non-compliance continues.

The Vestry of St. George-the-Martyr, Southwark, is the first Sanitary Authority that has gained a conviction, and this quite recently, under the sixteenth section of the 1883 Act, without asking the Court to order means to be adopted by the occupier for the purpose of removing the ground of complaint. In the case cited, the prosecution did not apply for this order, since the Medical Officer of Health was of opinion that the premises were incapable of being made fit for use as a bakehouse.

The magistrate inflicted the full penalty with costs, and made no order for removing the ground of complaint for the reason stated above.

Sub-sections one and two of the seventeenth Section of the 1883 Act have been repealed—so far as London is concerned—by Section one hundred and forty-two (*vide* fourth Schedule) of the Public Health (Lond.) Act, 1891.

Sub-section three of the same seventeenth Section has been repealed by section thirty-nine (*vide* second Schedule) of the Factory and Workshop Act, 1891.

The present law for the regulation of the metropolitan bakehouses, summarised and reproduced in the following two Sections of the Public Health (London) Act, 1891, reads as follows:—

"Section 26.—(1). Sections thirty-four, thirty-five, and eighty-one of the Factory and Workshop Act, 1878, and Sections fifteen and sixteen of the Factory and Workshop Act Amendment Act, 1883 (which relate to cleanliness, ventilation, and other sanitary conditions), shall, as respects every bakehouse which is a workshop, be enforced by the Sanitary Authority of the district in which the bakehouse is situate, and they shall be the local authority within the meaning of those sections.

"(2). For the purpose of this section, the provisions of this Act with respect to the admission of the Sanitary Authority and their officers into any premises for any purpose in relation to nuisances shall apply in like manner as if they were herein re-enacted and in terms made applicable to this section; and every person refusing or failing to allow the Sanitary Authority or their officer to enter any premises in pursuance of those provisions for the purposes of this section shall be subject to a fine."

"Section 27.—If any child, young person or woman is employed in a workshop, and the medical officer of the Sanitary Authority becomes aware thereof, he shall forthwith give written notice thereof to the factory inspector for the district."

By Section ninety-six of the Factory and Workshop Act, 1878, "child" means a person under the age of fourteen years; "young person" signifies a person of the age of fourteen years and under the age of eighteen years; and "woman" is defined as a female of eighteen years of age and upwards.

The only remaining special legislation affecting retail bakehouses is to be found under Section 26, Sub-sections 1 and 2 of the Factory and Workshop Act, 1891. This Section obliges every person within one month after opening a bakehouse to serve a written notice upon the District Factory Inspector, acquainting him of the fact. The Section further imposes upon the Inspector the duty of forwarding the notice forthwith to the Sanitary Authority of the district in which the bakehouse is situate.

The chief conclusions at which I have arrived may be stated somewhat as follows:—

(1). That it is advisable by means of a Select Committee of the House of Commons to enquire into the bakehouse question.

(2). That in case the Committee advise fresh legislation they shall prepare a Bill incorporating their recommendations with the Public Health (London) Act, 1891.

(3). That it should be rendered an offence to occupy as a bakehouse any cellar or place almost or altogether below the level of the street, unless it had been so occupied before and up to a certain fixed date.

(4). That all bakehouses be compulsorily licensed, and that such license be renewable annually.

(5). That the granting of licenses be vested in the London County Council.

(6). That uniform Metropolitan bye-laws regulating the conduct of the retail bakeries be made by the County Council and be confirmed by the Local Government Board; and that the duty of enforcing these bye-laws devolve upon the various Sanitary Authorities.

(7). That such bye-laws shall cover: (*a*) The regulation of the conduct of the business; (*b*) The regulation of the structure of the premises; (*c*) The regulation of the mode in which application is to be made for sanction to establish anew the business of a baker in the County of London.

(8). That the bye-laws relating to structure and comprised under heading (*b*) do not apply to existing bakeries until after the lapse of a certain number of years.

(9). That the question of compensation for disturbance of existing right in bakeries be taken into consideration by the Parliamentary Committee.

(10). That no dealing with the question of the regulation of bakehouses will be complete unless it investigates the relations between the millers and the retail bakers. At present the small tradesmen are often completely under the thumb of the capitalist millers.

(11). That inspection of bakehouses should be more systematic and thorough. To fulfil this condition an increase of the staff of Sanitary Inspectors is imperative.

(12). That a more intelligent knowledge of the whole question of their bread supply is desirable on the part of the public.

(13). That the weight of the sacks of flour should be reduced from 280 to 140 lbs.

To my mind, the ill-health of the baker is, in the main, the result of the bad surroundings in which he works. If baking be carried on in well-ventilated places, with a perfect sanitary environment, there is no reason why it should be a particularly dangerous or unhealthy trade. It is open to question how far the State should be called upon to fix the hours of labour of the journeyman baker. Without entering, however, into the discussion of that difficult and complex economical problem, it may, I think, on the other hand be emphatically asserted that there is much in the present condition of the retail bakehouses which calls for stringent legislative interference.

Prof. W. H. **Corfield** (London) said that if underground bakehouses were as they had been described, and he knew that many were, everybody would agree that they ought to be abolished. In Dr. Waldo's scheme notice was to be given to bakers to reform their bakehouses within a certain period; but he was of opinion that not too much notice should be given them. As a case in point, he referred to the Act passed for the abolition of private slaughter-houses. This Act allowed a period of forty years for all private slaughter-houses to be abolished. Thirty-eight years after the passing of this Act, as no steps whatever had been taken to abolish private slaughter-houses, a Bill was brought in exempting them from abolition. So that in this case after forty years' notice things remained just the same as ever. Although the duty of inspecting bakehouses was in the hands of the Home Office, for three years there was, so far as he had been able to ascertain, practically no bakehouses inspection whatever. Many improvements had now been introduced into some underground bakehouses, but he thought it was far better to get rid of them altogether than to try and improve them.

Dr. **Louis C. Parkes** (London) thought that the proportion of underground bakehouses in London was more like seven-eighths than that mentioned by Dr. Waldo, viz., a half. He thought that underground bakehouses were liable to be unhealthy, and although much had been done to remedy their unsanitary conditions still a great deal of dampness and bad ventilation remained. Where food was being prepared it was most important that there should be no dampness, and moreover he thought it impossible to ventilate underground rooms without immediately creating a draught, which bakers very naturally objected to. He expected it would be found that the comparative mortality of lung diseases among bakers would be high. It was impossible to do much with underground bakehouses, and their gradual abolition would probably be the best course. He agreed with Dr. Waldo that bakehouses should be licensed, and that the London County Council should have power to make regulations in regard to them, regulating them similarly to slaughter-houses. The insanitary conditions of bakehouses no doubt affected the public health to a certain extent, but it should not be lost sight of that the process of baking sterilised the bread and, therefore, destroyed all germs of disease. After being baked the crusts of the loaves might become contaminated under unwholesome conditions, and in epidemic times it was advisable to have bread re-baked at home. All bakehouses should be made sanitary, and the work commenced at once and done gradually. Kitchens were also important, as some were in a still worse condition than bakehouses. The audience would recollect the correspondence in the newspapers some time ago about the kitchens of foreign restaurants. At one of the large London exhibitions he went over one of the kitchens, and found in it two bell traps with steam issuing from the drains and a water-closet situated in close proximity to the kitchen. If this was the state of affairs in a high-class establishment, what must it be in a low-class one? He thought it very desirable that there should be a special inspection of all kitchens, and that this was almost more important than that of bakehouses, as the act of baking tended to sterilise or destroy the germs whereas from kitchens many things were served up in a raw state.

Mr. **W. G. Lakeman** (H.M. Superintending Inspector of Workshops for London) thought that Dr. Waldo's paper had been read opportunely, at a time when public thought was being exercised for the good of humanity. County Councils and local authorities were being awakened to a sense of their duties, and were beginning to assist the heads of the Government in carrying out the measures so wisely introduced. In 1863 a Commission was appointed to enquire into the bakehouse question, and as a result of their report an Act of Parliament was passed appointing the local authorities inspectors of bakehouses. They did nothing, and at the end of twenty years instead of an improvement things were worse. They had no time and no one else had any time, because no one was paid to do the work. In 1879 the inspection of bakehouses was transferred to Factory Inspectors, with the result that in fifteen months from 2,000 to 3,000 bakehouses were inspected and reported to the Government. In some instances the reports showed that large cesspools had been found situated immediately under the kneading troughs. As a result of these reports the Act of 1883 was passed, but he would ask what was the use of this Act and what good had it done? The local authorities found they could not undertake the work as they had too much to do already, so that from 1883 till quite recently no thorough inspection of bakehouses had been made, and now although the Home Office Inspectors work in harmony with the local authorities in carrying out the work of inspection, he was of opinion that until the Act of 1883 had been abolished and a new one passed on the lines suggested by Dr. Waldo the result would not be entirely satisfactory. He pointed out that in Glasgow and Belfast the sanitary condition of bakehouses was all that could be desired, and yet in London there was scarcely any underground bakehouses that could be said to be so. The master of a bakehouse was frequently a representative of the miller or contractor under whose thumb he was. He submitted that the hours were too long. Why should the men work 16, 17, and 18 hours out of the 24? In this matter inspectors had power to prevent young persons being overworked, but they could do nothing for the men, who, if they refused these hours, must in consequence suffer a loss of wages. He hoped that we should soon have such legislation for bakehouses as would ensure their being built on hygienic principles.

Mr. JOHN BLANDY (London) objected to the lecturer's use of the word cellars as applied to underground bakehouses, he considered they should be termed basements. If basement bakehouses were done away with, why not also basement kitchens and basement factories and workshops? And if all basement establishments were abolished, how would the owners manage as to rent, having regard to the great value of land in London? He believed that attention was wisely directed to pure air and good ventilation, but thought it would be a great mistake to abolish basements: far better retain them and make their sanitary condition proper and clean. He could not agree with Dr. Parkes as to germs being killed by being sterilised in the baking. He considered that cleanliness was to be aimed at, whether above ground or below.

Mr. T. A. GORNIOT (London) said that the case mentioned by the lecturer was not the first action under the Act. The Vestry of St. Marylebone closed a bakehouse some time ago for a period of six weeks, and obtained penalty under the section; and in September last they obtained a closing order under the Public Health (London) Act 1891, until the Vestry's notice to put the premises in a sanitary condition has been carried out. He thought that everybody would agree to the abolition of underground bakehouses, especially if they could see the unhealthy conditions under which the men employed in them had to work, in comparison to the advantages obtained in those built above ground.

Mr. B. A. BRAIEN (London) said that cellar bakehouses, or as he preferred to call them, basement bakehouses, contained the oven and were not damp. He entirely disagreed with the assertion that a great deal of the baking business was in the hands of the millers. He said that in London, want of room was a great difficulty, and that if underground bakehouses were done away with, he failed to see where the necessary ground for the bakehouses was to be obtained. Under the present system of short leases, a baker could not afford to build above ground, as the landlord would in consequence raise the rent after the expiration of the lease. He had done his best to advocate cleanliness, but if underground bakehouses were done away with, the baking trade, except the large factories, would be done away with also.

Mr. THORNTON (London C.C.) asked the lecturer if he had suggested to his local authority to communicate with the Local Government Board urging the amendment of the Law relating to bakehouses, as he knew Dr. Waldo had taken more interest and trouble in the matter than anyone else. The evils were only too apparent, even bakers themselves deplored them. He could not agree with Mr. Lakeman as to the Act of 1883. It was not a matter for surprise that the Vestries had taken no action. They were largely composed of interested property jobbers and those interested in the business, and it was owing to this that nothing was done, and not from want of time. There was not sufficient interest taken in the representation of the Vestries. He did not think the matter should be handed over to the London County Council, but rather that the Local Government Board should provide regulations which should be enforced by District Councils. If this were done thoroughly and properly, and the country possessed more Medical Officers like Dr. Waldo, the bakery business would become as healthy as any other.

Dr. WALSH (London) said that the assertion as to landlords confiscating the leases of bakehouses, was an argument against the law of landlords and not against sanitation. If you reformed the bakehouses, you would no doubt drive out the small baker. The public would gain in the end, but, as a class, the journeyman baker would suffer. He would venture to ask if the conversion of an ordinary house into a bakery increased the value of the property? Also whether Dr. Waldo was aware that many insanitary bakehouses belonged to the City or other Corporations, and whether they were taking any steps to remedy their condition, and if not, why were they not prosecuted?

Mr. **Vickers** (London) said that ordinary people would conclude from the lecture that bakers were the blackest of sinners, and he thought the lecturer had drawn greatly on his imagination. No doubt there were dirty bakehouses, and no trade could show a clean sheet, but bakers had too much at stake to allow their premises to be in such a condition as that described. If such a state of affairs became known, their trade would be ruined. One might conclude from the lecture there was no inspection of bakehouses, but he could say from experience both as the owner of a bakehouse and a member of the Health Committee of a Vestry, that inspection was both systematic and regular. He submitted that inspectors did perform their duty and the trade had no right to be blackballed. The Vestries were quite able to cope with the evils, and he counselled people not to be afraid to eat their bread.

Dr. **James Priestley** (London) quite agreed with Dr. Waldo, that there was urgent need for reform in the matter of the sanitary arrangements and condition of bakehouses; need for suitable by-laws and for the licensing of bakehouses. Dr. Waldo's description of the "typical" bakehouse as it occurred in his parish would not apply to the average bakehouse in the parish of Paddington. He had visited all the bakehouses in the latter parish, and only two or three could be passed as requiring no amendment. The average height of the ceilings was about eight feet. He did not see how underground bakehouses were to be done away with, but the erection of any new underground bakehouses could be stopped. He was opposed to the handing over of the control of bakehouses to any other authority; let the supervision remain with the Medical Officer of Health.

Dr. **Waldo** (London), in reply, said that there was much to answer, but he would endeavour briefly to meet the chief points raised. Dr. Parkes had given seven-eighths as the proportion of underground bakehouses to the total number of bakeries in London. This was an over-estimate, and calculating from data in his possession, he thought three-fifths would fairly express the correct proportion. Ninety-nine per cent. of the master bakers in the metropolis were Germans. With regard to bread made in cellar bakeries not being injurious to the public, he would point out that in various parts of London reflux of sewage accompanied heavy rainfalls. In one day, in October last, he had entered twenty cellars—situated in a main road leading to the Kentish capital—and had found them all flooded with sewage.

He considered that such conditions were highly dangerous. The bread—after it came out of the oven—lay about the filthy bakery and was very liable to be contaminated. Another source of danger was contact with the hands of the men, which were frequently soiled.

There was rarely—if ever—any provision for washing save in the same utensils as used for bread-making.

With regard to kitchens, he had not had time enough to go into the subject. He agreed that kitchens were too often bad or worse than bakehouses, but the work in them was less by night and in length of hours than in bakeries.

Mr. Lakeman had struck at the root of the evil when he charged the millers with sweating and vested interests. The influential millers, so far as legislation was concerned, were masters of the situation, and they could block or pass a Bill by appealing to the owners of the land upon which the corn was raised, who sat in the Houses of Parliament.

He saw no difference between the terms "basement" and "cellar," as applied to retail underground bakeries. Call them by what name you will it is absolutely impossible to efficiently ventilate or render healthy these places which were never constructed or intended for the manufacture of bread. He did not see why the bakehouse should not be removed to the top of the house—as was the case in so many kitchens—where there was no room to erect one on the ground floor. This would not entail great extra expense, and would besides render the house a much healthier one to live in.

In answer to Mr. Thornton, L.C.C., he had suggested in his reports to the Vestry of St. George-the-Martyr, that there should be more frequent inspection, and on his recommendation their staff of Inspectors had recently been doubled. Inspection was now made once every three months. This was a step in the right direction. He had also suggested legislation to do away with cellar bakeries, but had received little encouragement from the Local Government Board. He believed in the distribution of Local Government. He said the London County Council should make the by-laws, subject to the approval of the Local Government Board, and that the Local Authorities should carry out the work, not the London County Council to do everything.

Dr. Walsh had pertinently asked whether the City Corporation possessed insanitary bakehouses. As a matter of fact, some of the worst bakehouses in Southwark did belong to the City of London. He was of opinion that the establishment of a bakery on any premises raised the value of such property.

More than one gentleman—in the trade, he presumed—had stated their opinion that he had drawn somewhat on his imagination. He could, however, vouch for everything he had said, and all his remarks were made from personal observation, not on mere hearsay. He was not so well acquainted with the West End, but he had lived in the South and East End and visited many of the bakeries. There the state of things was so bad that it called, in his opinion, for immediate attention at the hands of the Legislature.

LECTURE TO SANITARY OFFICERS.

SANITARY BUILDING CONSTRUCTION.

By Keith D. Young, F.R.I.B.A.

13th February, 1894.

The essential points of healthy construction may be summed up as follows:—

1. A site which is clean and dry.
2. Efficient protection from the admission of both air and moisture from the subsoil into the house.
3. Walls and roof which will effectually keep out wet, and to some extent be proof against fluctuations of heat and cold.
4. Materials sound in quality and free from organic impurities.
5. Rooms of sufficient size for habitation, properly lighted, and provided with suitable means of ventilation.

Our first point then is the site. In order properly to appreciate the conditions which make for health or the reverse in the ground underneath us it is essential to have some knowledge of the formation of the earth's crust, or what is called Geology. We cannot, of course, within the limits of a lecture of this kind go beyond the merest rudiments of the science, but I think a brief statement of the main facts will be useful. Rocks (all soils are called rocks by geologists) are divided into two main classes—Igneous or metamorphic rocks, and aqueous or sedimentary rocks. With the first class, which consist of the granites, traps, and their allies, we need not concern ourselves; they occur nowhere within a long distance of London. The sedimentary rocks include all the various strata which have been at sometime or another deposited by the action of water. Chalk, clay, sand, sandstone, gravel, and the limestones all belong to this class. These are divided again into three classes—The siliceous or sandstones; the calcareous or limestones; and the argillaceous or clays. Besides these rocks there is usually to be found a surface soil which consists mainly of altered or decomposed earth derived from the soil beneath. In towns the surface soil often reaches to a considerable depth, and consists largely of the waste products of human life and buildings.

These various rocks which form the subsoil differ very widely in their physical characteristics. Some are of an extremely dense and impervious nature, such as clay. Others, again, are light, loosely compacted, and permeable, such as sand—and between these two extremes are many degrees of density and porosity. The various strata which go to make up the earth's surface are superimposed one upon the other in a certain definite order—which is never reversed; a particular stratum or a whole series of rocks may be absent, but the order in which they are found is absolute and never varied.

The two chief points that we have to consider in relation to the subsoil are, 1st, the presence of water at a greater or less depth from the surface, and 2nd, the presence of air.

The water in the subsoil, with which we must all be familiar, and which is met with in some places a few feet below the surface, whilst in others it is a considerable depth down, is derived from the rain which falls on the surface of the earth. Assume, for example, a site composed of the following:—surface soil of humus or mould one foot thick; below that, gravel ten feet thick, and below that again, the blue clay of the London basin. Of the rain falling on ground of this nature, part no doubt would pass into the air by evaporation, the remainder would percolate down through the gravel until it reached the clay, upon the surface of which it would be held up as in a basin. The depth of this underground water would probably be liable to greater or less fluctuations with the rainfall according as its way of escape was easy or the reverse.

Comparatively little is known of the phenomena which govern the level of underground water, but this much we may take as an established fact, that in all soils there is, at a greater or less depth from the surface, a continuous sheet of water; and that the soil above this water line contains more or less moisture.

There is, also, air within the interstices of the soil. There indeed are very few soils that are impermeable to air. It is said that a block of apparently solid gravel contains one third as much air as stone. Professor Pettenkofer enclosed a canary bird in a glass cylinder with a solid bed of gravel below his feet and another above his head, so that he could draw no air for respiration except through the gravel. The bird had abundance of air and suffered no inconvenience in the process.

This ground air, as it is called, is in constant movement; it is, in fact, set in motion by the action of the wind on the earth's surface.

In relation to this constant movement of the ground air, it is important to know something of the conditions to which the air is subject when enclosed in the subsoil. It is found that ground air always contains a greater percentage of carbonic acid than atmospheric air, and this fact is doubtless due to the organic decomposition which goes on in the subsoil. When therefore the ground underneath a house is made up of the *débris* from ash-pits or midden-steads, or contains, may be, one or two old cesspools, you will readily understand the kind of air which is likely to issue from the surface from time to time.

Let me give you two illustrations of the extreme importance of excluding the ground air from the interior of a house. The first is a case described by Dr. Reid, the Medical Officer to the Staffordshire County Council. In a cottage situated about twenty or thirty yards from the shaft of a disused coal mine, certain cases of illness had occurred, the symptoms of which pointed to poisoning by a very dangerous gas called carbon monoxide. The shaft referred to communicated with a mine which was in work. To facilitate ventilation in the mine which was in work, a fire had been lit, and suspended in the shaft of the disused mine, and this furnace had set fire to the coal in the latter mine. The cottage in question is the end of a row, and has a cellar which has an opening into the outer air. This opening was usually covered over by a piece of board which effectually excluded the air from the cellar. For several weeks previous to the occurrence of the illness in question, the surface of the ground had been frozen hard, and covered with snow. What therefore happened was this: the gas generated in the mine, finding no way of exit through the frozen and snow-covered surface of the ground, had penetrated the subsoil until it reached the ground under the house, where it found a ready exit. In the adjoining house, the cellar opening was covered with a board which did not fit well, and consequently allowed some of the gas to escape. In this cottage, the inmates suffered from the same illness, but in a much less severe form.

The second case is one related by Professor Pettenkofer of a house in Munich where recurrent attacks of illness took place, and the patient in each case recovered immediately on being removed to another house. In this instance the illnesses were definitely traced to poisoning by coal-gas. As in the case related by Dr. Reid, the ground outside was frozen hard, and it was found, on the breaking up of the frost, that a leak existed in the gas-main in the street immediately opposite the house in question, and that the gas had percolated through the soil until it found a ready outlet in the unfrozen earth under the house.

The facts related in these two examples may very well have occurred in perfectly undisturbed, natural or virgin soil; indeed, in the Staffordshire case the soil very probably was a virgin one. Consider, then, the possibilities of a soil treated in the way the average speculating builder treats it when there is no local authority with power and will to restrain him. First of all, the turf comes off and is sold; then the gravel, or sand, or stone is excavated, and either carted away or used for building purposes. The excavation thus made then becomes a tip for rubbish of all sorts, a fee being charged for the privilege of depositing the filth. The site thus prepared and levelled up becomes an eligible building site for dwellings. Now, inasmuch as it has been determined by experiment that it takes three years for ordinary organic refuse to become entirely decomposed and rendered innocuous, and probably a very much longer time for fœcal matter to undergo a similar change, it will be evident that a house built upon such a foundation will, unless proper precautions are taken, be liable to draw in a large supply of exceedingly polluted air.

We have, then, to consider by what means we are to exclude from our houses the air and moisture contained in the ground beneath us, and how we are to protect the walls from the damp which creeps up by capillary attraction.

To prevent the admission of air or mere moisture from the subsoil, it will be sufficient to spread over the surface of the ground a stratum or layer of some impervious material. Concrete, composed of Portland cement or lias lime, and clean gravel, and finished either with asphalte or with an inch thick surface of cement and sand in equal parts, will be found an efficient protection. But a thin skin of lime concrete with no attempt at a really impervious surface will be little better than nothing. The by-law on this matter promulgated by the late Metropolitan Board of Works is curiously inadequate to the requirements of the case. It provides that in all cases, except where the soil is gravel, sand, or natural virgin soil, it shall be covered with a layer of good concrete six inches thick and smoothed on the upper surface. "Good" concrete may very well be made of lime, and, as a matter of fact, usually is so made—and for this purpose, is perfectly useless. The exception of the three kinds of soil shows how hopelessly ignorant of the subject the framers of by-laws must have been; for they probably represent the very three kinds of subsoil in relation to which it is most important to take protective measures. Even the model by-laws of the Local Government Board are hardly clear enough on this point. They admit of no exceptions, and they require the site to be covered with asphalte or with good cement concrete, rammed hard. Effectually to prevent the passage of ground air, the concrete must be covered with an impervious layer, as it is not in itself impervious to air. The by-law ought, therefore, to require that the surface should be covered with cement concrete 6 in. thick and its surface finished either with rock asphalte ¾ in. thick, or with cement and sand in equal parts 1 in. thick.

In many cases, as, for example, in cellars, sculleries, wash-houses, and the like, the surface of the concrete may well become the finished floor-surface. Indeed, I think it would be a good thing if all open spaces, underground and basement floors were prohibited. With wooden floors of the ordinary construction it is necessary to provide ventilating openings in the external walls in order to guard against the occurence of dry rot. In nine cases out of ten these openings are promptly stopped up to prevent the inconvenience caused by the draughts that arise, and if not stopped up they are really little better than channels for conveying the moist and stagnant air around the foundations to the interior of the house. Where wood floors, therefore, are needed I would either lay wood blocks in asphalte or bitumen direct on to the surface of the concrete, or I would nail ordinary boards to wood fillets imbedded in the concrete.

If, by reason of the height of the water-level in the subsoil, and the depth to which it is desired to excavate for a basement storey, it becomes necessary to take steps to keep out actual running water, some further precautions will be required. If practicable, a series of open-jointed drain pipes should be laid under the floor of the basement and connected either to a drain if one exists a sufficient depth, or, better still, carried to some natural outlet such as a ditch. The outside of the walls from the ground line down to the foundation should be lined with asphalte or Portland cement, or they may be built hollow, as we shall presently see. But unless the ground can be efficiently under drained, it is really hopeless to expect to keep your basement dry. Better abandon the attempt altogether than incur the constant and abiding trouble and danger of a damp basement.

There remains one other way by which the moisture in the subsoil makes its entrance into the house, to the detriment of the structure and the injury of its inmates, and that is by creeping up the walls in obedience to the law of capillary attraction. The absorbent power of some kinds of brick is very great; some bricks, such as malms, will retain as much as 22 per cent. of their own weight of water. The matter is put with remarkable clearness by the late Mr. Eassie, in his little book called "Sanitary Arrangements for Dwellings."

He takes the case of a house designed by himself; in the construction of this about 180 rods of brickwork, or rather over four-fifths of a million bricks were used. The foundations under the ground line occupy about 8,000 cubic feet, and represent 115,000 bricks, presenting an upright surface of about 5,000 square feet to the damp or possibly wet earth. Such foundations would contain about 5,000 gallons of water through the ordinary operations of the bricklayer, and would in addition, if the subsoil were humid, absorb and retain 7,000 gallons in addition to the water contained in the mortar. If therefore no means are taken to prevent it, this wet will be continually creeping up the walls along a horizontal surface of about 2,400 superficial feet. The same authority affirms that damp arising in this way has often been traced to a height of 30 feet above ground.

In order to prevent damp rising up a wall, it is necessary to insert at a point above the ground level, but below the ground floor, an impermeable layer or damp-proof course which may be made of one or other of the following materials:—

1. Slates in cement.
2. Vitrified stoneware.
3. Asphalte.
4. Staffordshire blue bricks in cement.
5. Lead.

A slate damp course should be made with stout slates laid between two stout beds of cement, and the slates themselves laid breaking joint, that is the joint between two slates of the upper layer must occur over the centre of the slate of the lower layer. This is an old-fashioned, but if properly formed, a very efficient damp-proof course.

Vitrified stoneware was first used for this purpose by the late Mr. John Taylor, the architect of St. George's Hall, Langham Place. His object was to combine a damp-proof course with a ventilating air brick—an excellent intention, but, as I have pointed out, I think it far better to abolish the space *in toto.*

Asphalte, if it be really asphalte, makes a perfect damp course—but the cheap substitutes that are too frequently used, and contain no asphalte whatever, are worthless. The composition of these substances is usually coal-tar, pitch boiled with chalk, and sand. Such damp courses are affected by variations of temperature, and when warm are squeezed out of place by the weight of the superincumbent brickwork.

Staffordshire blue bricks are commonly used for damp courses in the north, and if well laid in cement are quite effectual.

Lead cannot be said to be in common use as a damp course on account of its cost. It is, however, a very effectual one, and is not liable to be injured by unequal settlement of the superstructure, as might be the case with slates or asphalte.

We have already spoken of the means to be taken to keep out water from a basement storey, but even in well-drained subsoils there will always be some amount of moisture in the ground. This may be dealt with in several ways.

1. The outside of the wall may, as before pointed out, be cemented or asphalted.

2. A hollow space may be built in the wall and two damp courses fixed. This method is an illustration of the Model By-law No. 17. It appears that there is a legal difficulty in framing a by-law providing for coating the outside face of a wall with an impervious material, because the coating would form no part of the structure itself and the clause must apply to the structure alone. Such a double wall must be tied together with suitable ties of iron or stoneware placed at distances apart not exceeding 3 feet horizontally and 18 inches vertically.

3. A dry area may be constructed outside the main wall and independent of it. The cavity is usually covered over above the ground level, but should be ventilated and drained.

So far we have been dealing with the effects of dampness rising or percolating from the ground. There are, however, several other ways in which damp will if not prevented penetrate through outer walls. For example rain will drive through a brick or stone wall in many exposed situations, and here it will be well to consider for a moment the relative permeability of different kinds of materials in use for outer walls. It is probably known to you that there are many kinds of bricks in common use, some of which absorb nearly or quite a tenth of their own weight of water, and there are some kinds of stone which are capable of taking up even a greater amount than this. When, therefore, we have to deal with a material of so absorbent a nature we must either build the walls of such a thickness that only the outer skin, so to speak, will be affected, or we must cover them with some less pervious material, such as cement, slates, or tiles, or we must build them hollow. The latter method is, perhaps, the best as the hollow space forms a non-conducting curtain as it were, and prevents much of the radiation of heat outwards in winter and inwards in summer that takes place through a wall of ordinary construction. The construction of a hollow wall needs careful attention, not only as regards the provision of sufficient and properly devised bonding ties, but also to ensure that the inter space is kept clear.

For this purpose a lath of wood of the exact width of the inter-space should be inserted between the inner and outer wall and moved upwards with every course of bricks; this prevents the inter-space being filled up with mortar. The inter-space, moreover, ought to be ventilated and the heads of doors and windows covered with sheet lead to prevent damp falling on and rotting the woodwork.

Damp has a way of getting into walls by creeping in under copings and window sills that do not project, or if projecting have no throating. It will also soak down through chimney stacks or down parapet walls when no proper provision is made to prevent its doing so. Chimney stacks should always have sloping tops built up with tiles and cement, and caps of sufficient projection to throw the water off, and the upper parts of chimney stacks with all the projecting courses should be built in cement and not in mortar. It is also very advisable to insert a damp course in chimney stacks just above the roof.

Party walls where they rise above the roofs must be so constructed that the wet will not soak down. To this end, they must be furnished with a coping which may be constructed either of bricks on edge set in cement with a projecting course of double tiles also set in cement, and having a weathered fillet on their upper surface; or of stone projecting each side at least two inches, and having on each under side a groove or throat to throw the water off.

Where the roof joins the upright brickwork either of wall or chimney stack, the joint must be covered either with lead, or with a cement fillet. Lead flashing which consists of strips of lead laid on the slating or tiling, and turned up against the brickwork, the turned up part being covered over with pieces of lead tucked into the joints of the brickwork, is undoubtedly the soundest way of doing the work, but it is also expensive. A well made cement fillet will last a long time.

Before leaving this part of our subject, let me just say a word or two on the paving of back yards and courts. How often is it the case that the back yards of houses, and also the courts which form the common means of access to them, are either not paved at all, or rough, covered with cobbles or bricks or ill-fitting stone flags, the gaping joints of which afford a ready harbour for the accumulation of all kinds of filth. The ground thus exposed becomes saturated with the *debris* of all the refuse which gets deposited on its surface, which again serves to poison the air when given off by evaporation. The proper and efficient paving of all court-yards, passages, and house yards, and the provision of drainage for the surface should be a matter of compulsion, not only in regard to new houses but also in old ones. The paving of yards can now be the subject of by-laws under the Public Health Amendment Act, 1890, when that Act has been adopted by the Local Sanitary Authority (see Model Clause in *Knight's* "Model By-Laws," under that Act—not annotated, and not the model of the Local Government Board, but a good model, nevertheless). A point of detail that is not uncommonly lost sight of is, that in setting out the paving of yards the fall should be arranged with regard to the use the yard is to be put to. In a house yard, for example, the paving should fall away from the house so that the lowest part may be furthest from the walls, but in a school playground the highest part should be the centre of the space, so that the part where the children play shall be the dryest.

We now come to the question of roof-coverings. The materials in ordinary use for roofing are tiles, slates, lead, zinc, and thatch. Tiles are made in several ways; the plain tile is, as its name implies, rectangular in form, with two holes at its upper edge, through which the oak or iron pins are driven, on which the tile is hung to the lath or batten. The pan-tile is a flat tile, bent to a double curve and furnished with a small stub or projection, by which it is hooked on to the lath; variations of this are the double-roll tile and the corrugated tile, Taylor's patent tiles are narrower at one end than at the other, and have the edges at each side turned up, these are laid alternately as capping and channel tiles; and the Venetian or Italian tiles, which have a flat tile alternating with a roll. Of all these the plain tile is the best. Tiles are, however, heavy, and they absorb a considerable percentage of water, and must, therefore, be laid at a steeper pitch than slates. They are difficult to repair, and unless bedded on some yielding material are, in exposed situations, liable to damage from high winds. For this reason it is customary in many parts of the country to bed plain tiles in rushes; a practice involving the use of material liable to decay, which cannot be recommended. The desired object can be attained with equal efficiency by bedding the tiles in lime and hair. On the other hand, tiles are bad conductors of heat and, consequently, are a warm covering in winter and a cool one in summer. Pan-tiles are only suitable for covering the roofs of out-houses and buildings not intended for habitation.

Slates are much thinner and lighter than tiles, and being of a very compact crystalline nature readily admit of the passage of heat and cold through them. The best and stoutest slates come from Cumberland; they are usually green in colour and about a quarter of an inch thick. They are not sorted out into sizes as are the Welsh slates, but all sizes are mixed. When laid on a roof the smaller sizes are fixed next to the ridge and they gradually increase in size until they reach the eaves. Welsh slates for the most part are blue or rather purple in colour and are made in certain regular sizes, those in most ordinary use being 20 inches by 10 inches and known as "Countesses." The best slates are those known as Bangor slates, and of these the greater proportion come from the famous Penrhyn Quarries. The signs of a good slate are hardness, closeness of texture, and small capacity for absorption. It should give a clear ringing sound when struck, and its edges should cut clean when dressed. A good slate when immersed in water to half its length will show no sign of moisture above the water line. A good slate also should be free from veins or dark streaks and should not contain lumps of iron pyrites, such as are frequently to be seen in an inferior kind of slate imported into this country from Germany.

Slates being much less absorbent than tiles can be laid at a much lower pitch. Large slates may be laid at an angle of 22°, or one-fifth the span, ordinary slates as Countesses at an angle of 24½°, or one-quarter the span, and small slates at an angle of 33°, or one-half the span. The usual pitch for Countess slating adopted in practice is 30°. The most important point in laying slating is to allow sufficient lap. By lap is meant the distance by which each slate overlaps the next slate but one below it. "Gauge" is the depth of margin of each slate exposed below the tail of the slate covering it. Slates should always be nailed near the centre in preference to near the head (except in the case of very small slates), as the leverage when acted upon by the wind is so much shorter, and the chance therefore of its being blown up so much less. Slating so laid is also easier to repair. The objection urged to this mode of nailing is that when a slate slips, or gets blown off, the nail heads of the slate below are exposed, whereas with head nailing each nail-head is covered by two slates, and they would therefore not be exposed by the removal of one slate. I think, on the whole, that the balance of advantage is decidedly in favour of the centre nailing. The lap should never be less than three inches with Countess slates nailed near the centre; the guage is equal to half the length of the slate after deducting the lap. Thus, with a 3 in. lap, the guage = 8½ in., or 20 in. minus 3 in. divided by 2 = 8½. The nail holes are placed near the centre of the slate, but sufficiently near the head to clear the head of the slate below. The course of slates next the eaves is always double, and is tilted upwards in order to give a perfectly even bed to all the slates, and to prevent the occurrence of any open space into which the wind could penetrate.

In order to preserve a more equable temperature a layer of boarding is sometimes nailed over the rafters and on this sheet-felt is laid to act as a non-conductor. It is a very good plan to fix the slates on battens over the felt as by so doing an air space is obtained between the felt and the slates which further increases the non-conducting property of the former.

Lead and zinc are used chiefly for flat roofs. The great cost of lead is prohibitory to its use in the smaller class of dwellings. It is heavy also and involves the use of stronger framework to support it than is the case with zinc. The chief difficulty with lead is its liability to expansion and contraction with changes of temperature. For this reason no single piece of lead in a flat roof should be larger than ten feet by three feet, a quarter of a sheet. The current at which it is laid should not be less than one inch in ten feet, and the sheets should be laid lengthwise in the direction of the current. Where the sheets join one another lengthwise the lead is dressed over semi-circular wooden rolls, and at the ends a drop of two inches is formed, the upper and lower lead being dressed to overlap. It is important to see that the upper lead does not reach down to the lower lead where it overlaps, otherwise the water will be sucked under the upper lead by capillary attraction.

Zinc is laid on very much the same principle as lead, but it is important to secure that no solder is used in fixing it. Zinc is, compared with lead, very light, the stoutest zinc weighing twenty-six ounces to the superficial foot, while for flats and gutters the weight of lead should not be less than seven pounds to the foot.

Thatch as a roof covering, notwithstanding its great advantage as a most efficient non-conductor of heat, is wholly unsuitable for dwelling-houses. It is in effect prohibited by the Model By-Law (No. 52), which requires that new buildings shall be covered with slates, tiles, metal, or other incombustible material. This By-law is framed under Section 157 of the Public Health Act, 1875, which empowers Urban Authorities and Rural Authorities too, when they have been invested by the Local Government Board with certain urban powers as allowed by the Public Health Act, 1875, to make By-laws with respect to the structure of walls, foundations, roofs, and chimneys, of new buildings for securing stability and the prevention of fires, and for purposes of health, and is clearly directed at that part of the section which relates to the prevention of fire; but with regard to thatch, the question of health is of equal importance to that of fire. Thatch is an absorbent substance liable to decay, and has been proved to have the power of retaining the infective germs of specific disease for an almost unlimited period. For these reasons thatch must be unhesitatingly condemned as a roof covering for dwelling houses. Such a material as tarred felt also, though possibly not so absorbent as and less liable to decay than thatch, is of a most combustible nature and as such would come under the prohibition of the By-law. Thatch has the further disadvantage that it does not permit of eaves gathering and consequently the rain water from the roof cannot well be collected, and is allowed to drip on the ground, so as to involve dampness in walls and foundations.

So far we have been dealing with the question of keeping out damp from the dwelling. We must now consider how the healthiness of a house may be affected by the nature of the materials of which it is built in other ways than by damp.

Mortar is a material which is very often made in a way which cannot fail to be injurious in the long run. Mortar should be made of lime and sharp sand. It is not infrequently made of road-scrapings mixed with garden mould. The Model By-laws specify "good" lime, but do not afford any clue to the question of what "good" lime as distinguished from "bad" is; neither is any rule given for the proportion of lime to sand. But in many codes of By-laws, the model clause has been so modified as to determine the proportions of materials used in mortar. Limes are divisible into three classes—Fat or rich limes, poor limes, and hydraulic limes. Fat limes are calcined from pure or nearly pure carbonate of lime. Poor limes are calcined from limestone containing from sixty to ninety per cent. of carbonate of lime together with useless impurities. Hydraulic limes are those which, after calcination, contain sufficient quicklime to develop the action of slaking, together with certain other constituents the chief of which is clay, which gives it the power of setting quickly without drying. The kind of lime commonly used in ordinary work is what is commonly known as grey lime, and is feebly hydraulic; but in neighbourhoods where lias lime is readily obtainable, it should always be used in preference to any less hydraulic lime. The fat or rich limes are not suitable for making mortar, but being purer than the hydraulic limes, are better adapted for internal plastering. The sand for making mortar should be clean, sharp sand; in other words pure sand, without any admixture of clay or earthy matter. The test for a good sand is very simple. If you take a handful of pure, sharp sand, and rub it in the palm of your hand and then throw it away, it will leave no stain behind. The reverse will happen if the sand is impure. The By-laws in force in the metropolitan area require the sand for mortar to be clean, sharp, sand, without earthy matter, a most important point.

The proportion of sand to lime is usually two-and-a-half of the former to one of the latter by bulk. Of substitutes for sand there are: burnt clay; if this is used care must be taken that the clay is thoroughly burnt and well crushed in a mill, half-burnt clay seriously injures the mortar; crushed stone; the refuse from a mason's yard makes excellent mortar provided it is clean and the stone from which it comes is gritty. Slag from furnaces, clincker from brick kilns, and scoriæ from iron works make excellent substitutes for sand provided they are clean and properly used.

The quality of bricks or stone of which walls are built will affect the healthiness of the house in so far as they are more or less absorbent, and on this subject we have already dwelt.

It will be convenient however briefly to notice the chief points to be noted as characteristic of good and bad bricks, and the various kinds of bricks in ordinary use.

A good brick then should be hard, well and evenly burnt, square and regular in shape with clean sharp arrises, should give a clear ringing sound when struck, and should be as non-absorbent as possible.

Of the ordinary London stock there are many varieties; there is the true bright hard stock, which it is so difficult to get now-a-days; then there are place bricks, grizzles, and chuffs. Place bricks and grizzles are those which come from the outside of the clamp or kiln and are more or less imperfectly burnt. Chuffs are bricks upon which rain has fallen when hot making them full of holes and quite unfit for use. The best stock bricks for facings obtainable are those called shippers. A great many bricks which are delivered as picked or washed stocks for facings are in reality second-class malms, and usually soft and absorbent. Malms are bricks made specially for facings, and are made from the same clay as that of which stocks are made with the admixture of marl or chalk. Best malms are good sound bricks, the inferior qualities not.

Of red bricks the best for London use come from Fareham. Good red bricks also are sent to London from Leicestershire. A very excellent brick is the deep-coloured Luton brick, a good many of which have been used in London of late years. Glazed or enamelled bricks which are so plentifully used now-a-days are made of fire-clay. The best kind are made by machinery, then dried and pressed and the glaze applied. They are then burnt in kilns at a very high temperature.

Concrete bricks made of coke breeze and of Portland cement are extremely useful for fixing joiners' work to, and thus doing away with wood bricks or slips.

The hair used by the plasterer in making the coarse stuff or first coat hang together may if not of proper quality be a most insanitary material. It should be long, sound, clean ox hair, and should be absolutely free from grease or dirt of any kind. If these conditions are not fulfilled you can readily imagine the kind of impurities that might be incorporated with the walls.

Apart from the materials themselves, there are modes of construction that are eminently productive of unwholesome conditions. Such as the practice of leaving hollow spaces behind skirtings instead of continuing the plaster right down to the floor boards. So, too, with the ordinary way of constructing floors. The system of laying beams or joists across from wall to wall, and on the top of them, fixing the floor boards while the under side is covered up with lath and plaster, is admirably calculated for the formation of ever increasing stores of dirt of all kinds. The evil can, to a great extent, be mitigated by barring the passage between the joists, but it would be far better to form our floors of solid concrete with the boards laid on fillets embedded in it, as is the custom in so many places abroad. The whole tribe of casings, including such unnecessary nuisances as enclosures to baths, sinks, and water-closets are abominations, whose only functions are to harbour filth. Chases for pipes too are wholly unnecessary, and indeed most objectionable. As was well remarked by Mr. Statham in his paper on "Some Insanitary Superstitions in House Building," at the Congress of Hygiene in 1891, "Among other drawbacks, they (chases for pipes) form a private lift or elevator for the cockroach, who is fond of warmth, and is enticed to ascend along the line of the hot water pipes. The cockroach is bad enough in the kitchen, but a good deal worse in the bedroom; it is hardly worth while to afford him the luxury of a private passage, heated by hot water, to the upper floors."

We now come to my fifth point which is that dwelling rooms shall be of sufficient size and efficiently lighted and provided with adequate means of ventilation. The question of size is one which practically regulates itself. There is, however, a point affecting the height of rooms which is of material importance to health. It is essential that every occupant of a room should have sufficient breathing space, and the provision of this breathing space will, it is pointed out in a memorandum recently issued by the Local Government Board, be materially facilitated or hindered according to the height of the room. Assuming for example that a room 12 ft. by 12 ft. 6 in. and 8 ft. high is sufficient for three people, allowing 400 cubic feet per head.

If the height of this room is reduced to 7 ft. the floor space is increased from 150 ft. to over 171 ft. and the natural tendency would be to add another bed and thus reduce the cubic space per head from 400 ft. to 300 ft. If, therefore, the height of rooms were restricted by law to a minimum of 8 ft. over the whole area the possibility of overcrowding would be materially reduced. In rooms partly in the roof the memorandum referred to suggests that the mean height over the whole area should be 8 ft. and the minimum height 5 ft. The diagrams appended to the memorandum I have had copied to a large size and they illustrate clearly how the end in view is to be obtained. One great object attained by the limitation of the height of the side walls under the sloping part is that beds cannot be put on the floor in close proximity to the roof, as is so often the case.

Provision for adequate lighting is made by By-Law No. 57 in the Model Code, which prescribes that every habitable room shall have one window at least opening into the external air, the area of which, or if there be more than one window, then the area of all the windows, clear of the sash-frame, shall be equal to at least one-tenth of the area of the floor of the room. You will observe that this By-Law renders the provision of at least one window of a size proportionate to the area of the room imperative, to the exclusion of borrowed lights or skylights. The difficulty of framing any rule that would apply equally to all kinds of rooms with varying conditions of aspect and surroundings will be obvious to everyone. I think you will find in practice that the rule laid down in the By-Law gives a very fair minimum, at the same time it must be regarded distinctly as a minimum.

Closely allied to the subject of efficient lighting is the necessity for provision of open space about a dwelling-house. The absence of any regulations or by-laws governing this very important provision has led in part to the formation of those narrow, dark, and noisome courts and alleys so commonly to be met with in our great towns. The process has usually been that the owner of houses to which back gardens were attached has found it to be to his profit to erect other houses on the gardens and to form narrow passages of approach between or under the front houses.

This contingency is provided against in the Model By-Laws of the Local Government Board by Clause 53, which prescribes that a clear space of at least twenty-four feet across, measured to the opposite side of the street if necessary, is to be provided in front of any dwelling-house. Clause 54 prescribes that every house is to have at its rear, and extending its whole width, an open space belonging exclusively to it, measuring from a minimum of ten feet up to twenty-five feet across, according to the height of the building.

It is further prescribed (Clause 55) that adequate windows are to be provided in each storey of the building in the walls which abut upon the open spaces so provided in front and rear.

The effect of these clauses is to prohibit the erection of dwellings with narrow courts between, or of back to back houses, and besides providing for a sufficiency of air they also provide for efficient lighting.

The by-laws relating to open spaces are subject to modification under special conditions; as for instance where a house is placed at the junction to two streets forming an acute angle. For this and similar cases alternative by-laws are to be found in the Model Code.

We have now, gentlemen, as far as the limits of a single lecture would permit travelled over the whole range of our subject. We have necessarily dwelt much upon detail, and have not had much time to spare for broad principles. Let me, therefore, in conclusion, urge upon you the importance of careful, intelligent study of the main principles which underlie all the laws of health. The practical application of these laws which has its expression in Public Health Acts, Building By-laws and the like, is but the concentrated result of the patient careful observation of the relation between unhealthy conditions and disease extending over many years, the records of which are to be found in the reports of the Medical Officer to the Privy Council and to the Local Government Board, and in the reports of Medical Officers of Health throughout the country. Believe me an intelligent study of the relation between the causation of disease and insanitary conditions will not only give an added interest to your work but will help you to do your work with more profit both to the community, whose interests you serve, and to yourselves.

ANNUAL REPORT OF THE COUNCIL,

FOR THE YEAR 1893.

Read at the Ordinary General Meeting, April 4th, 1894.

INTRODUCTION.

During the year 1893 very rapid progress has been made in all branches of Sanitary Science, now one of the most popular subjects of the day; that this is largely due to the efforts that have been made by the Institute to promote the diffusion of Sanitary knowledge there can be little doubt. · In presenting this Report (the 18th since the foundation of the Institute) the Council are glad to record a considerable development in the various branches of Public Health work undertaken by the Institute.

SESSIONAL MEETINGS.

Sessional Meetings were held in February, March and April. The following papers were read and discussed:—

"Light, Air and Fog." GEORGE VIVIAN POORE, M.D., F.R.C.P.

"The Housing of the Working Classes," H. PERCY BOULNOIS, M.INST.C.E., City Engineer, Liverpool.

"Notes on the Working of the London Main Drainage System." W. SANTO CRIMP, M.INST.C.E., District Engineer, London County Council.

The papers, with abstracts of the discussion upon them, are published in Vol. XIV. of the Transactions of the Institute.

LECTURES FOR LADIES.

The Sixth course of Lectures on Domestic Hygiene, especially intended for Ladies, was given during Lent by A. T. SCHOFIELD, M.D., M.R.C.S., the subjects treated being:—

"Home Sanitation in special reference to Cholera, Typhoid, and Diphtheria."

"Neglected Facts of Hygiene in Childhood and Home Life."

"Some Recent Sanitary Reforms and Revolutions."

"The Hygiene of Nerves, or Brain Hygiene with reference to Overpressure in Girls' School Life."

The Lectures were illustrated by Diagrams, Microscopic Specimens, Remedial Furniture, and by a Demonstration of Electrical Cooking Apparatus.

LECTURES ON THE SANITATION OF INDUSTRIES AND OCCUPATIONS.

The Council has had under consideration the question of the Sanitation of Industries. In a reply to a deputation of those interested in the subject, the Home Secretary foreshadowed the probability of a considerable increase in the number of Factory Inspectors and of the future registration of workshops. The new Inspectors would be elected from the working classes, who are familiar with practical, social, and working conditions, but not necessarily conversant with the scientific conditions and health requirements. In addition to this, the Sanitary Inspectors of local authorities have by recent legislation had cast upon them a large increase of work hitherto performed by Factory Inspectors, which has led to special Sanitary Inspectors being detailed for these duties in many districts.

In these circumstances, the Council thought it desirable to arrange a course of free public lectures on the Sanitation of Industries and Occupations, to be delivered by well-known authorities, both for the purpose of giving information to those responsible for the management of factories, and instructing those likely to become Factory Inspectors. The course comprised:—

1. "Occupation and Mortality." **ARTHUR NEWSHOLME, M.D.LOND., M.R.C.P., D.P.H.**, Medical Officer of Health, Brighton.
2. "Mineral (Non-Metallic) Dusts, the Manufacture of Pottery, &c." **J. T. ARLIDGE, M.D. and A.B.LOND., F.R.C.P.LOND.**, late Milroy Lecturer at the Royal College of Physicians, London.
3. "Metallic Dusts, Cutlery, Tool Making, and other Metal Trades." **SINCLAIR WHITE, M.D., D.P.H.CAMB., F.R.C.S.ENG.**, Lecturer on Public Heath, Sheffield School of Medicine.
4. "Textile Manufactures, Silk, Cotton, Woollen and Linen Industries." **J. T. ARLIDGE, M.D. and A.B.LOND., F.R.C.P.LOND.**
5. "Metallic Poisons. Lead and Arsenic." **PROF. T. OLIVER, M.A., M.D., F.R.C.P.LOND.**, Professor of Physiology, University of Durham, Gouldstonian Lecturer, Royal College of Physicians, London.
6. "Manufacture of Alkalies and Acids." **WATSON SMITH, F.I.C., F.C.S.**, Lecturer in Chemical Technology in University College, London.

These six Lectures do not, of course, cover the whole range of the subject, but arrangements are being made to continue and extend the Lectures in 1894.

The Lectures excited considerable interest, and they have been published by request in a separate pamphlet as well as in the Transactions.

LECTURES FOR SANITARY OFFICERS AND STUDENTS.

Two courses of Lectures and Demonstrations for Sanitary Officers have been held in London during the year. The first course was held in February and March, for which 108 Students entered their names, the average attendance, including Members and Associates, being 94.

The Lectures comprised in this course were:—

1. "Ventilation, Warming, and Lighting." Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.
2. "Water Supply, Drinking Water, Pollution of Water." Louis Parkes, M.D., D.P.H.LOND., Medical Officer of Health, Chelsea.
3. "Principles of calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale." H. Law, M.INST.C.E.
4. "House Drainage." W. C. Tyndale, ASSOC.M.INST.C.E.
5. "Sewerage and Sewage Disposal." Prof. H. Robinson, M.INST.C.E.
6. "Sanitary Building Construction." H. H. Collins, F.R.I.B.A.
7. "Sanitary Appliances." Prof. W. H. Corfield, M.A., M.D.OXON., Medical Officer of Health, St. George's, Hanover Square.
8. "Details of Plumbers' Work." J. Wright Clarke.
9. "Scavenging, Disposal of House Refuse." Charles Mason, ASSOC.M.INST.C.E., A.R.I.B.A., Surveyor, St. Martin's-in-the-Fields.
10. "Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for Food." Prof. A. Wynter Blyth, BARRISTER-AT-LAW, M.R.C.S., Medical Officer of Health, St. Marylebone.
11. "General Powers and Duties of Inspectors of Nuisances." J. F. J. Sykes, M.B., B.SC., D.P.H., Medical Officer of Health, St. Pancras.
12. "Objects and Methods of Inspection." J. F. J. Sykes, M.B., B.SC., D.P.H., Medical Officer of Health, St. Pancras.

13. "Infectious Diseases and Methods of Disinfection." LOUIS PARKES, M.D., D.P.H.LOND., Medical Officer of Health, Chelsea.
14. "Nature of Nuisances, including Nuisances the abatement of which is difficult." ARTHUR NEWSHOLME, M.D., D.P.H., Medical Officer of Health, Brighton.
15. "Trade Nuisances." PROF. A. BOSTOCK HILL, M.D., D.P.H.CAMB., F.I.C.
16. "Sanitary Law. English, Scotch, and Irish; General Enactments Public Health Act, 1875; Model Bye-Laws, &c." PROF. A. WYNTER BLYTH, BARRISTER-AT-LAW, M.R.C.S., Medical Officer of Health, St. Marylebone.
17. "Sanitary Laws and Regulations Governing the Metropolis." PROF. A. WYNTER BLYTH, BARRISTER-AT-LAW, M.R.C.S., Medical Officer of Health, St. Marylebone.

At the second course, in October and November, 147 students entered their names, the average attendance, including Members and Associates, being 126.

A Lecture on Elementary Physics was added in order to give the Students a knowledge of the general principles referred to in the Lectures.

The Lectures comprised in the second course were:—

1. "Elementary Physics." J. F. J. SYKES, D.SC., M.D., Medical Officer of Health, St. Pancras.
2. "Ventilation, Warming, and Lighting." SIR DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.
3. "Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale." H. LAW, M.INST.C.E.
4. "Water Supply, Drinking Water, Pollution of Water." J. WALLACE PEGGS, ASSOC.M.INST.C.E.
5. "Sanitary Building Construction." KEITH D. YOUNG, F.R.I.B.A.
6. "Sanitary Appliances." W. C. TYNDALE, ASSOC.M.INST.C.E.
7. "Details of Plumbers' Work." J. WRIGHT CLARKE.
8. "Sewerage and Sewage Disposal." PROF. H. ROBINSON, M.INST.C.E.
9. "House Drainage." W. C. TYNDALE, ASSOC.M.INST.C.E.
10. "Scavenging, Disposal of House Refuse." CHARLES MASON, ASSOC.M.INST.C.E., A.R.I.B.A., Surveyor, St. Martin's-in-the-Fields.

11. "Diseases of Animals in Relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for food." PROF. A. WYNTER BLYTH, BARRISTER-AT-LAW, M.R.C.S., Medical Officer of Health, St. Marylebone.
12. "Infectious Diseases and Methods of Disinfection." SHIRLEY F. MURPHY, M.R.C.S., Medical Officer of Health for the County of London.
13. "General Powers and Duties of Inspectors of Nuisances." J. F. J. SYKES, M.B., B.SC., D.P.H., Medical Officer of Health, St. Pancras.
14. "Objects and Methods of Inspection." J. F. J. SYKES, M.B., B.SC., D.P.H., Medical Officer of Health, St. Pancras.
15. "Nature of Nuisances, including Nuisances the abatement of which is difficult." ARTHUR NEWSHOLME, M.D., D.P.H., Medical Officer of Health, Brighton.
16. "Trade Nuisances." PROF. A. BOSTOCK HILL, M.D., D.P.H. CAMB., F.I.C.
17. "Sanitary Law: English, Scotch, and Irish; General Enactments, Public Health Act, 1875; Model By-Laws, &c." PROF. A. WYNTER BLYTH, BARRISTER-AT-LAW, M.R.C.S., Medical Officer of Health for St. Marylebone.
18. "Sanitary Laws and Regulations Governing the Metropolis." LOUIS PARKES, M.D., D.P.H.LOND., Medical Officer of Health, Chelsea.

Arrangements were made in connection with these Lectures for the Students to visit the places mentioned below. The names of the gentlemen who kindly arranged the visits and conducted the Students are also given;—

Sewage and Destructor Works, Ealing. CHAS. JONES, M.INST. C.E., Engineer and Surveyor, Ealing Local Board.

Beddington Sewage Irrigation Farm, Croydon. THOS. WALKER, M.INST.C.E., Borough Engineer, Croydon.

Express Dairy Company's Farm, College Farm, Finchley, and Establishment at Heath Street, Hampstead. G. TITUS BARHAM, Managing Director.

Hornsey Sanitary Depôt, Sewage Disposal Works, and Isolation Hospital. T. DE COURCY MEADE, M.INST.C.E., Engineer and Surveyor, Hornsey Local Board.

Wimbledon Sewage Farm. C. H. COOPER, ASSOC.M.INST.C.E., Engineer and Surveyor, Wimbledon Local Board.

East London Soap Works. E. COOK & Co..

St. Pancras Disinfecting Station, Disinfecting Apparatus, Destructor Furnace, Vans for Infected and Disinfected Clothing, Ambulance, Coach Houses, Stores for Disinfectants, &c., Family Shelter for Persons during Disinfection, Infectious Mortuary, General Mortuary, Poor Law Mortuary, Post Mortem Room and Coroner's Court. J. F. J. SYKES, D.SC., M.D., Medical Officer of Health.

Parish of Chelsea: Visit of Inspection to Guinness' Buildings. LOUIS PARKES, M.D., D.P.H., Medical Officer of Health.

St. George's, Hanover Square: Visit of Inspection to Sanitary Works in different stages of progress, Disinfecting Station, Mortuary, &c., Model Dwellings (Gatliff Buildings), and Routine Office work of a Sanitary Inspector. A. TAYLOR, Chief Sanitary Inspector.

East London Water Works, Lea Bridge. W. B. BRYAN, M.INST.C.E., Engineer to the Company.

Leyton Sewage Works. W. DAWSON, ASSOC.M.INST.C.E., Surveyor, Leyton Local Board.

Friern Barnet Sewage Works. E. J. REYNOLDS, Surveyor, Friern Barnet Local Board.

South Norwood Irrigation Farm. THOMAS WALKER, M.INST.C.E., Borough Engineer, Croydon.

"Shone" System of Drainage, Houses of Parliament. EDWIN AULT.

Barking Sewage Outfall Works. SANTO CRIMP, M.INST.C.E., District Engineer, L.C.C.

London Subways. P. GUNYON.

The Institute has endeavoured in the orginazation and arrangement of these visits to make them as instructive as possible, and a pamphlet has been issued to Students, including a syllabus of the Lectures, and various particulars relating to places to be visited.

These arrangements have involved considerable expenditure on the part of the Institute, but the Council believe that they are of great value in giving practical instruction to Sanitary Officers.

The Students have also the free use of the Library and Museum at all times when they are open, and a special time is set apart each week for the Students to examine the Museum with the assistance of the Curator.

PROVINCIAL LECTURES.

Arrangements were made in conjunction with the County Councils or Corporations for Courses of Lectures to Sanitary Officers at the following Towns :—

Norfolk County Council	King's Lynn.
The Corporation of Exeter	Exeter.
The Corporation of Dublin	Dublin.
The West Riding County Council, The Yorkshire College, The County Boroughs of Halifax, Huddersfield, and Sheffield	Keighley. Huddersfield.
County Council and Town Council of Nottingham	Nottingham.

420 Students entered their names for these Lectures. The total attendance at all the Lectures was over 4,000, or an average of 62 at each Lecture.

The courses at the various centres consisted of the following Lectures :—

KING'S LYNN.

1. "Introductory—Ventilation, Heating, and Lighting." Louis Parkes, M.D., D.P.H.LOND., Medical Officer of Health, Chelsea, London.
2. "Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale." Henry Law, M.INST.C.E.
3. "Water Supply, Pollution of Water, Drinking Water." Major Lamorock Flower, Engineer to the Lee Conservancy Board.
4. "House Drainage and Sanitary Appliances." W. C. Tyndale, ASSOC.M.INST.CE.
5. "Scavenging, Disposal of Refuse, and Sewage." E. G. Mawbey, ASSOC.M.INST.C.E., Borough Surveyor, Leicester.
6. "Sanitary Building Construction." Percival Gordon Smith, F.R.I.B.A., Architect, Local Government Board.
7. "Infectious Diseases and Methods of Disinfection." Bushell Anningson, M.A., M.D., Medical Officer of Health, Cambridge.
8. "Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for Food." Prof. A. Wynter Blyth, Barrister-at-Law, M.R.C.S., Medical Officer of Health, St. Marylebone, London.

9. "Powers and Duties of Sanitary Inspectors." **Bushell Anningson**, M.A., M.D., Medical Officer of Health, Cambridge.
10. "Objects and Methods of Inspection." **J. C. Thresh**, M.B., D.SC.LOND., Medical Officer of Health, Essex County Council.
11. "Sanitary Law, General Enactments, Public Health Act, 1875. Model Bye-Laws, &c." **J. F. J. Sykes**, M.B., B.SC., Medical Officer of Health, St. Pancras, London.
12. "Nuisances and Offensive Trades." **Prof. A. Bostock Hill**, M.D., D.P.H.CAMB.

Exeter.

1. "Introductory, and on Ventilation, Heating, and Lighting." **Louis Parkes**, M.D., D.P.H., Medical Officer of Health, Chelsea, London.
2. "House Drainage and Sanitary Appliances." **George Reid**, M.D., D.P.H., Medical Officer of Health, Staffordshire County Council.
3. "Sanitary Building Construction." **W. J. Fletcher**, F.R.I.B.A., County Surveyor, Dorset.
4. "Details of Plumbers' Work." **J. Wright Clarke**.
5. "Scavenging, and Disposal of Refuse." **C. Jones**, M.INST.C.E., Surveyor Ealing Local Board.
6. "Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for food." **Arthur Newsholme**, M.D., D.P.H., Medical Officer of Health, Brighton.
7. "Water Supply, Drinking Water, Pollution of Water." **Edward Walford**, M.D., D.P.H.CAMB., Medical Officer of Health, Cardiff.
8. "Objects and Methods of Inspection, including Vessels." **F. M. Williams**, M.R.C.S., D.P.H.CAMB., Medical Officer of Health, Plymouth.
9. "Infectious Diseases and Methods of Disinfection." **F. M. Williams**, M.R.C.S., D.P.H.CAMB., Medical Officer of Health, Plymouth.
10. "Powers and Duties of Sanitary Inspectors; Nuisances and Offensive Trades." **D. S. Davies**, M.D.LOND., D.P.H.CAMB., Medical Officer of Health, Bristol.

11. "Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws, &c." PROF. A. WYNTER BLYTH, M.R.C.S., BARRISTER-AT-LAW, Medical Officer of Health, St. Marylebone, London.
12. "Principles of Calculating Areas, Cubic Space, &c.; Interpretion of Plans and Sections to Scale." D. CAMERON, City Surveyor, Exeter.

DUBLIN.

1. "Introductory." SIR CHARLES A. CAMERON, M.D., D.P.H., Superintendent Medical Officer of Health, Dublin.
2. "Ventilation, Heating and Lighting." SIR DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.
3. "House Drainage and Sanitary Appliances." PROF. W. H. CORFIELD, M.A., M.D.OXON., Medical Officer of Health, St. George's, Hanover Square, London.
4. "Details of Plumbers' Work." W. R. MAGUIRE, ASSOC.M.INST.C.E.I.
5. "Sanitary Building Construction." T. HARNETT HARRISON, F.R.I.B.A., ASSOC.M.INST.C.E.
6. "Scavenging, and Disposal of Refuse." H. PERCY BOULNOIS, M.INST.C.E., City Engineer, Liverpool.
7. "Water Supply, Drinking Water, Pollution of Water." W. KAYE PARRY, M.A., C.E.
8. "Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for food." FRANCIS VACHER, F.R.C.S., F.C.S., Medical Officer of Health, Cheshire County Council.
9. "Infectious Diseases, and Methods of Disinfection." PROF. ANTONY ROCHE, M.R.C.P.I., L.R.C.S.I.
10. "Powers and Duties of Sanitary Inspectors; Nuisances and Offensive Trades." J. BRYNE POWER, M.R.C.P.I., D.P.H., Medical Officer of Health, Kingstown.
11. "Objects and Methods of Inspection." FRANCIS VACHER, F.R.C.S., F.C.S., Medical Officer of Health, Cheshire County Council.
12. "Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale." W. GOLDSTRAW, Surveyor of Buildings, Liverpool.
13. "Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws, &c." D. EDGAR FLINN, F.R.C.S., D.P.H.

KEIGHLEY AND HUDDERSFIELD.

1. "Common Legal Difficulties in the Work of Sanitary Inspectors." HENRY SAYER, Deputy Town Clerk, Sheffield.
2. "Sanitary Inspection with reference to Infectious Diseases." THEODORE THOMSON, M.D., M.A., Local Government Board Inspector.
3. "Drainage of Villages and Isolated Dwellings." W. SPINKS, ASSOC.M.INST.C.E., Lecturer on Sanitary Engineering, Yorkshire College.
4. "The Dairies, Cowsheds, and Milkshops Order." HARVEY LITTLEJOHN, M.B., Medical Officer of Health, Sheffield.
5. "Smoke Abatement." JAMES R. KAYE, M.B., Medical Officer of Health, Huddersfield.
6. "Water Supply in Rural Districts." J. MITCHELL WILSON, M.D., Medical Officer of Health, Doncaster Borough and Doncaster combined Sanitary Districts.
7. "The Adulteration Acts." TREVOR C. EDWARDS, West Riding Solicitor.
8. "Factories and Workshops." J. SPOTTISWOODE CAMERON, M.D., B.SC., Medical Officer of Health, Leeds.

NOTTINGHAM.

1. "Introductory; Ventilation, Warming, and Heating." SIR DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.
2. "Methods of Measuring Areas, Cubic Space, &c.; the Interpretation of Plans." HENRY LAW, M.INST.C.E.
3. "Soils and Sub-soils, with reference to their suitability for Building Purposes." M. J. R. DUNSTAN, M.A., F.R.S.E., F.I.C.
4. "Plumbers' Work." A. H. SIMPSON, F.R.MET.SOC., University College, Nottingham.
5. "House Drainage, Sanitary Appliances and Domestic Sanitation." PHILIP BOOBBYER, M.B., Medical Officer of Health, Nottingham.
6. "Scavenging, and Disposal of Refuse in Town and Country." HARVEY LITTLEJOHN, M.A., M.B., Medical Officer of Health, Sheffield.
7. "Duties and Powers of Sanitary Inspectors: in (*a*) Urban Districts; (*b*) Rural Districts." GEORGE REID, M.D., Medical Officer of Health, Staffordshire County Council.

8. "Infectious Diseases and their Prevention. Disinfection." J. PRIESTLY, B.A., M.D., D.P.H., Medical Officer of Health, Leicester.
9. "Diseases of Animals affecting Man through Food Supplies, &c." ALFRED HILL, M.D., Medical Officer of Health, Birmingham.
10. "Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws, &c." PROF. A. WYNTER BLYTH, BARRISTER-AT-LAW, Medical Officer of Health, St. Marylebone.
11. "Water Supply, Drinking Water, Pollution of Water." B. A. WHITELEGGE, M.D., B.SC., D.P.H., Medical Officer of Healtl, West Riding County Council.
12. "Systems of Sewerage and Sewage Disposal." ARTHUR BROWN, M.INST.C.E., Borough Engineer, Nottingham.

A number of Visits and practical Demonstrations were arranged in connection with the Lectures at Huddersfield, Keighley, and Nottingham, similiar to those provided for the students attending the London Lectures.

The Council desire to record their sincere thanks to the Lecturers both in London and the provinces for the great benefits they have conferred upon the Students, and for the assistance they have given to the diffusion of Sanitary knowledge, by the preparation and delivery of these Lectures, and also to those who have taken so much trouble to make the various visits instructive to the Students.

EXAMINATIONS.

FOR LOCAL SURVEYORS.

During the year two Examinations have been held in London and one in Dublin.

At these Examinations 28 Candidates presented themselves, and 20 received Certificates of Competency, as regards their Sanitary knowledge, to discharge the duties of Local Surveyors.

The Council have thought it desirable to discontinue these Examinations.

For Sanitary Inspectors.

Two Examinations were held in London and one at each of the following places:—

Worcester.	Leeds.
Lynn.	Cardiff.
Exeter.	Newcastle.
Dublin.	Manchester.

At these Examinations 510 Candidates presented themselves, and 240 were certified competent, as regards their Sanitary knowledge, to discharge the duties of an Inspector of Nuisances under the Public Health Act, or of a Sanitary Inspector under the Public Health (London) Act.

The Council are glad to note that an increasing number of Sanitary Authorities now recognise the desirability of Sanitary Inspectors holding a Certificate of competency. There are now 30 Sanitary Authorities in the Metropolis and over 100 in the Provinces who mention this requirement in the official advertisements for these officers, and the Council trust that this qualification will soon be compulsory throughout the kingdom.

Since these Examinations were first established 89 have been held, 33 for Local Surveyors, and 56 for Inspectors of Nuisances, and 2,579 Candidates have been examined, of whom 118 have passed the Examination for Local Surveyors, and 1,380 that for Inspectors of Nuisances.

SANITARY LEGISLATION.

During the year 1893 many Bills, relating more or less to Public Health, were introduced into Parliament. Although only a few of these passed into law, they were all carefully watched by the Parliamentary Committee of the Institute; and it may be well to include in this report a list of these measures, and a note of the action, if any, taken by the Council.

Cholera Hospitals (Ireland) Bill. Brought in by Mr. John Morley and Sir Walter Foster.

A Bill to enable Sanitary Authorities in Ireland to take possession of land for the erection of temporary Cholera Hospitals.

This Bill received the Royal Assent on June 9th, 1893.

Drainage Separation Bill. Brought in by Mr. Stephens.

A Bill to enable Local Authorities to separate house drainage from rain and surface water.

This Bill was dropped.

Infectious Hospitals Bill (Lords). Brought in by The Lord Thring.

A Bill for enabling County Councils to promote the establishment of Hospitals for the reception of patients suffering from infectious diseases, and to enable County Councils, upon the report of the Medical Officer, to acquire sites and to build and administer hospitals, and establish training schools for nurses.

The Council sent some recommendations to Lord Thring.

The Bill received the Royal Assent on Dec. 21st, 1893.

Plumbers' Registration Bill. Brought in by Mr. Knowles, Sir Algernon Borthwick, Earl Compton, Mr. Dixon, Dr. Farquharson, Mr. Bowen Rowlands, and Mr. Sexton.

The Plumbers' Registration Bill, the provisions of which were considered in 1892 by the Committee, was again introduced into Parliament.

The Council sent suggestions to the supporters of the Bill. The Standing Committee on Trade reported on the Bill, which was not further proceeded with.

Public Health Acts Amendment Bill. Brought in by Sir F. S. Powell, Dr. Farquharson, Mr. H. T. Hobhouse, Sir Reginald Hanson, Mr. Kendrick, Mr. Knowles, and Mr. H. J. Wilson.

A Bill to amend the Public Health Acts with respect to Common Lodging Houses. This Bill gives, Clause 1: Discretion as to registration of lodging-house keeper; Clause 2: An obligation on common lodging house keeper to provide for the proper control of his house; Clause 3: Power of court convicting common lodging-house keeper to cancel registration; Clause 4: Puts penalties on unregistered lodging houses; Clause 5: Provides for proper sanitary conveniences in common lodging houses; Clause 6: Consists of interpretation clauses; Clause 7: Declares that the Act is to be taken as one with the Public Health Act, 1875, and the Acts amending the same.

The Council sent several criticisms on the Bill to the members supporting it.

The Bill was eventually withdrawn.

Public Health (London) Act Amendment Bill. Brought in by Mr. James Stuart.

This Bill dealt only with the financial clauses of the Act, and received the Royal Assent on Sept. 12th, 1893.

Public Health (London) Bill. Brought in by Sir H. E. Roscoe, Sir A. K. Rollit, Mr. Bousfield, Mr. Howell, and Mr. H. L. W. Lawson.

A Bill to amend and extend the Public Health (London) Act 1891.

The Council sent several criticisms on the Bill to the members supporting it, and to the London County Council.

The Bill was dropped.

Rivers Pollution Prevention Bill. Brought in by The Viscount Cross.

A short Bill to explain two sections of the Rivers Pollution Prevention Act, 1876.

The Bill received the Royal Assent on July 27th, 1893.

Rivers Pollution Prevention Bill, No. 2. Brought in by Sir Francis Powell.

The principal object of this Bill was to improve the law for preventing the pollution of streams, by extending to the whole of England (as far as applicable), the provisions of the Mersey and Irwell (Private) Act of 1892.

While supporting this Bill, the Council deemed it unnecessary to petition in favour thereof, as they considered it would not need support.

The Bill was subsequently withdrawn.

Sanitary Registration Bill. Brought in by Mr. Martin, Sir Algernon Borthwick, Dr. Cameron, Dr. Farquharson, and Mr. Wootton Isaacson.

The Sanitary Registration Bill has been before Parliament for several years. By the provisions of the Bill compulsory legislation was proposed, under which every dwelling-house, school, college, hospital, asylum, workhouse, factory, work-shop, hotel, and lodging-house would have to be inspected by what is called in the Bill, licentiates in Sanitary practice. The Council considered that a new authority to regulate Sanitary matters would be thus created, which would inevitably clash with already constituted Local Authorities.

The Council petitioned against the Bill, and Sir Francis Powell presented the petition to the House.

The Bill was dropped.

Local Government (England & Wales) Bill. Brought in by Mr. Henry H. Fowler.

The Sanitary provisions of this Bill were considered by the Council but no action in reference thereto was taken. The Bill received the Royal Assent at the end of the session, 1893-4.

BY-LAWS OF THE LONDON COUNTY COUNCIL.

The Draft By-Laws of the London County Council made under the Public Health (London) Act, 1891, were referred by the Council of the Institute to a Committee for consideration, and a large number of amendments, many of which were of considerable Sanitary importance, were forwarded to the London County Council. The Council are glad to note that the more important of these amendments were adopted by the County Council, and incorporated in the By-Laws, which have been approved by the Local Government Board and issued to the public.

FLUSHING REPORT.

The desirability of altering the Regulations made under the Metropolis Water Act, 1871, so as to allow a larger quantity than two gallons of water to be used for flushing water-closets, was brought before the Local Government Board by several Metropolitan Sanitary Authorities, from Nov., 1892, to May, 1893, and the matter was referred by the Local Government Board to the London County Council. The London County Council applied to The Sanitary Institute for an opinion upon the question before replying to the Local Government Board. As the proposition was of considerable sanitary importance, the Council of the Institute carried out a series of special experiments on the subject, and recorded the results for the general information of those interested in the question. The report containing these records was published separately, and a copy was forwarded to the London County Council. It is also included in Volume XIV. of the Transactions.

After receiving this report and making some further enquiries, the County Council in December last sent an expression of opinion to the Local Government Board that the Regulations made under the Metropolis Water Act, 1871, should be altered, so that every water-closet flush cistern should be so constructed as to be capable of discharging three gallons of water at each flush. This recommendation was referred back to the County Council by the Local Government Board as not being within the purport of the Regulations referred to, which have for their object the prevention of waste, misuse or contamination of water. They have therefore slightly modified the wording, and have agreed, on the recommendation of their Public Health Committee, to make application to the Water Companies to amend the Regulations in the direction desired.

In addition to these investigations a considerable amount of experimental work has been carried on during the year in the judging of Sanitary Apparatus and Appliances selected for further practical trial at the Portsmouth Exhibition of the Institute.

CHARTER.

The application of the Institute for the grant of a Royal Charter was heard by the Privy Council in April last, but after consideration the Council informed the Institute, that while fully recognising the useful work done by it, they had not found themselves able to recommend Her Majesty the Queen to grant a Charter.

THE PARKES MUSEUM.

Many additions and changes of Exhibits have been made during the year, and in nearly all the sections something of interest has been done. Among the most notable may be mentioned:—The installation of Electric Supply, which has been arranged to illustrate the adaptions of Electricity to Domestic Purposes, including Lighting, Heating, and Cooking. The various Instruments used for measuring the current, both as regards Voltagè and Consumption, can also be seen in action, and the practical application of the Light to the sections under the galleries facilitates the examination of the Exhibits. Several demonstrations of the convenience of Electricity for various purposes have been given during the year, particularly in connection with the Lectures to Ladies, when Cooking, Ironing, Heating, Ventilating, and Lighting Apparatus were specially lent and demonstrated by Messrs. Crompton & Co.

The purchase of an oxy-hydrogen Lantern with the necessary adjuncts, including slides, has considerably added to the facilities for illustrating Lectures, and several of the Lecturers have taken advantage of the apparatus.

A set of Microscopic Slides of Foods, &c., have been added to the Museum, and are available for the use of the Students.

A Collection of Apparatus for Demonstrating Physical Phenomena, including Syphonage, Pressure of Air and of Water, Capillarity, &c., has been found most useful.

To the Meteorological Section a Fortin's Barometer, presented by Dr. Whitelegge, has been added.

A number of small Models for Teaching Purposes have been collected, classified, and arranged for study.

A permanent form of numbering the exhibits has been adopted and carried out during the year, and is found to be a great improvement on the previous arrangement.

The preparation of a new Catalogue of the Exhibits is in a forward state, and will, it is hoped, be ready early next month.

The attendance both of visitors and students has considerably increased during the year.

	1892.	1893.	Increase.
Visitors to the Museum	16,575	18,606	2,031
Classes held	68	87	19
Number of Students	959	1,043	84
Lectures held	42	48	6
Total attendance at Lectures	3,812	4,991	1,179

Classes of Students have been brought to the Museum by the Examiners or Lecturers of a large number of Institutions, including:—

The Architectural Association.
The Central Y.M.C.A., Exeter Hall.
The Charing Cross Medical School.
The City and Guilds Institution.
The College of State Medicine.
The Croydon Y.M.C.A.
The Kindergarten Training College.
The London Hospital.
The University of London.
The Maria Grey Training College.
The Nurses' Training College.
The Polytechnic.
The London Post Graduate Course.
St. George's Hospital.
The Queen Victoria Jubilee Institution.
St. Thomas' Hospital.
Toynbee Hall.
Westbourne Park Institute.

Eleven Classes have been brought by private teachers, making 87 Classes, with a total of 1,043 Students.

The Museum has thus formed an influential centre for the dissemination of Sanitary knowledge.

No charge is made for the use of the Museum for these Classes, but the numbers are now so numerous that the Council have found it necessary for the convenience of those attending the Museum to require a formal application before a class is held.

LIBRARY.

The use of the Library is steadily increasing; during the year there have been 856 readers. 289 volumes and pamphlets have been presented to the Library since last report, A List of these is published in Vol. XIV. of the Transactions.

In the latter part of the year the Committee of the Internationa Congress of Hygiene and Demography voted to the Institute the sum of £160 towards the cost of preparing a Catalogue of the Library, which is much needed, and the work is now in hand, but further funds will be required to enable the Committee to print the Catalogue.

TRANSACTIONS.

The Transactions for the year 1893, Volume XIV. of the Series, has already been issued to the Members. The Volume contains a record of the Sessional Meetings, the Special Lectures on Sanitation of Industries, and, as frequent requests have been made for them, copies of some of the Lectures to Sanitary Officers. It also includes an Illustrated List of Exhibits to which Medals and Certificates have been awarded at the Exhibitions held by the Institute since its Incorporation in 1888.

Although not strictly belonging to the work of 1893, the Council think that the Members will be glad to know that it has been decided in future to issue the Transactions in the form of a Journal, that will be published quarterly and will contain general sanitary information in addition to a record of the work carried on by the Institute.

EPITOME OF REGISTERS OF MEMBERS AND ASSOCIATES.

	Hon. Fellows.	Fellows.	Members.	Associates.	Total.
Dec. 31, 1892	26	146	510	598	1280
Elected	—	+5	+42	+163	+210
Transferred	—	—	-5	-5	-10
Resigned	—	—	-25	-16	-41
Erased	—	-1	-13	-78	-92
Died	-3	-6	-12	-7	-28
Dec. 31, 1893	23	144	497	655	1319

It is with much regret that the Council have to report the death of:—Vice-Presidents and Fellows, The Rt. Hon. Lord Derby, K.G., LL.D., F.R.S., and Prof. J. Tyndall, D.C.L., LL.D., F.R.S.; Hon. Fellows, Dr. W. Roth, Dr. Giacinto Pacchiotti, and Dr. H. Marié Davy; Fellows, J. A. Archer, Sir William Bowman, Bart, M.D., LL.D., F.R.S., F. Le Gros Clark, F.R.S., and Insp.-Gen. R. Lawson, LL.D. (late Treasurer); Members, Marcus Beck, M.B., Mrs. E. Beevor, W. H. Brace, M.D., G. B. Carlton, ASSOC.M.INST.C.E., Rt. Hon. Lord Ebury, F. H. S. Murphy, M.D., D.P.H., Miss P. Parkes, J. D. Smith, M.D., D.P.H., Miss E. M. Wakefield, Charles Wheeler; Associates, W. C. Beck, A. Cheshire, R. W. Jasper, C. Savory, W. A. Shadrake, R. Thompson, R. J. Franks.

EXTENSION OF MUSEUM AND OFFICES.

The Council have for some time felt that the accommodation afforded by the present premises is very inadequate for the growing requirements of the Institute, caused by the rapid increase and development of its work. They have therefore commenced negotiations for obtaining additional premises in Margaret Street, adjoining the Museum.

FINANCE.

The various developments in the work of the Institute have necessitated a considerable increase in the expenditure, and the expenses for the year have absorbed the balance of receipts carried forward for the past three years, but do not necessitate any appropriation of capital to current expenses.

EPITOME OF THE WORK OF THE INSTITUTE, 1893.

London Lectures and Examinations.

		Total Attendance.
3	Sessional Meetings for the discussion of Sanitary subjects	308
4	Lectures to Ladies on Domestic Hygiene	350
6	Lectures on the Sanitation of Industries	461
35	Lectures to Sanitary Officers	3872
31	Practical Demonstrations for Sanitary Officers	963
2	Examinations Local Surveyors..	27
2	Examinations Sanitary Inspectors	284
87	Classes brought to Museum	1043
170		7308

Provincial Lectures and Examination.

65	Lectures to Sanitary Officers	4030
1	Examination Local Surveyors	1
8	Examinations Sanitary Inspectors	226
74		4257

T. CRAWFORD,
Chairman of Council.

E. WHITE WALLIS,
Secretary.

March, 1894.

STATEMENT of INCOME and EXPENDITURE

Dr.

Expenditure.	£	s.	d.	£	s.	d.
To Rent, Rates, Taxes, and Insurance	256	19	7			
„ Salaries and Wages	1051	14	0			
„ Coals and Care of Offices	47	18	7			
„ Repairs and Alterations	63	11	4			
„ Maintenance of Museum	37	7	2			
„ Library, Binding, &c.	8	12	4			
„ Postage and Carriage	92	0	0			
„ Printing and Stationery	154	4	7			
„ Advertising	17	12	5			
„ Incidental Expenses	98	13	7			
„ Law Charges	2	10	6			
„ Office Furniture	13	4	8			
„ Depreciation of Leasehold	50	0	0			
				1,894	8	9
To Transactions, Cost of Printing, &c., less Sales and Advertisements	306	7	9			
„ Sessional Meetings	16	9	0			
„ Lectures, Sanitary Officers	486	9	6			
„ „ Sanitation of Industries	59	19	0			
„ „ Domestic Hygiene	32	0	5			
„ Examinations	1,231	4	6			
„ Congress	6	19	3			
„ Exhibition	15	5	9			
„ Flushing Experiments	23	18	4			
				2,178	13	6
				£4,073	2	3

	£	s.	d.
To Expenses of Application for Charter, charged to Capital Account	532	2	5
„ Life Composition Fund (amount reserved in respect of previous Compositions)	178	10	0
„ Balance for the year 1893 brought down	657	18	11
	1,368	11	4
„ Balance to be carried forward	10,066	4	6
	£11,434	15	10

Examined and approved,

ALFD. LASS, WOOD & Co., Chartered Accountants, } *Auditors.*
MAGNUS OHREN, ASSOC.M.INST.C.E., }

for the Year ended 31st December, 1893.

Cr.

Income.	£	s.	d.	£	s.	d.
By Annual Subscriptions	864	15	7			
„ Entrance Fees	36	15	0			
„ Fellowship Fees	21	0	0			
„ Donations	4	4	0			
„ Interest on Investments	251	7	1	1,178	1	8
„ Illustrated List of Awards	7	7	11			
„ Lectures, Sanitary Officers	400	8	2			
„ „ Domestic Hygiene	27	15	10			
„ Examinations	1,800	12	6			
„ Publications — Farr's and Simon's — Profit on Sales	0	17	3	2,237	1	8
				3,415	3	4
„ Balance, excess of expenditure over income for the year 1893, carried down				657	18	11
				£4,073	2	3
By Balance brought forward from last account (1892)				11,434	15	10
				£11,434	15	10

GENERAL BALANCE SHEET,

Liabilities.	£	s.	d.
To Subscriptions paid in advance for 1894	28	7	0
„ Examination Fees „ „	44	14	0
„ Life Composition Fund	178	10	0
„ Library Catalogue Account..................................	163	11	2
„ Sundry Creditors	661	11	3
	1,076	13	5
„ Balance of Assets over Liabilities..........................	10,066	4	6
	£11,142	17	11

Examined and approved,

Alfd. Lass, Wood & Co., Chartered Accountants, } *Auditors.*
Magnus Ohren, Assoc.M.Inst.C.E.

31st DECEMBER, 1893.

Assets.	£	s.	d.	£	s.	d.
By Lease of Premises, 7 years unexpired ...	344	3	8			
„ Library and Contents of Museum, estimated value	500	0	0			
„ Furniture and Fixtures, estimated value	100	0	0			
„ Transactions and Publications, estimated value	599	4	9			
„ Farr's Works, estimated value	24	7	6			
„ Simon's „ „	98	10	0			
				1,666	5	11
„ Sundry Debtors—						
Members' Subscriptions in Arrear ...	101	6	6			
Fellowship Fees „ ...	5	5	0			
Entrance „ „ ...	26	5	0			
Amount due on account of Provincial Lectures............................	48	0	0			
				180	16	6
„ Cash at Bankers on Current Account ...	117	5	6			
„ „ „ on Deposit	178	10	0			
				295	15	6
„ Investment (£9,248 11s. 1d. Consolidated Stock) valued at				9,000	0	0
				£11,142	17	11

THOMAS CRAWFORD, *Chairman of Council.*

FELLOWS, MEMBERS & ASSOCIATES ELECTED,

From January to March, 1894, inclusive.

FELLOWS (FELLOW SAN. INST.)

Reg. No.	Date of Election.	
583	1894. Feb.	BOOBBYER, Phillip, M.B., M.R.C.S., M.O.H., *The Guildhall, Nottingham.*
688	1894. Feb.	CORNISH, Surg.-General, William Robert, F.R.C.S., C.I.E., Q.H.P., 8, *Cresswell Gardens, S.W.*
630	1894. Feb.	FOSBROKE, George Haynes, M.R.C.S., L.S.A., D.P.H.Cam. *Rose Place, Worcester.*

MEMBERS (MEM. SAN. INST.)

† Passed Examination as Local Surveyor.

‡ Passed Examination as Inspector of Nuisances.

803	1894. Feb.	†ADAMS, Henry Charles, 23, *Valentine Road, King's Heath, Worcestershire.*
808	1894. Mar.	BEESTON, Charles Samuel, *Architect and Surveyor, Ormskirk, Lancashire.*
809	1894. Mar.	†CLARE, Jesse, ASSOC. M. INST. C. E., *Local Surveyor, Sleaford, Lincolnshire.*
796	1894. Jan.	COBBETT, Wilberforce, *Civil Engineer, Fareham, Hants.*
810	1894. Mar.	‡HERROD, Herbert, *Surveyor and Sanitary Inspector, Barrow-upon-Soar, Loughborough, Leicestershire.*
797	1894. Jan.	†HILL, William Henry, Jun., *Audley House, Cork, Ireland.*
811	1894. Mar.	KING, Surg.-Major Walter Gawen, M.B., C.M., D.P.H., *Sanitary Commissioner, Fort St. George, Madras, India.*
804	1894. Feb.	†LEE, Lennie Henry, *Public Works Department, Calcutta, Bengal, India.*
805	1894. Feb.	MASON, John Sigismund, *Surveyor, Sierra Leone, West Africa.*
806	1894. Feb.	OKE, Francis Robt., ASSOC.M.INST.C.E., 5, *Coppentall Terrace, Crewe, Cheshire.*
814	1894. Mar.	O'SULLIVAN, John G., ASSOC.INST.C.E., *City Engineer's Office, City Hall, Dublin* (2 *Charleville Terrace, N.C. Road*).
812	1894. Mar.	PAIN, Coard Squarey, ASSOC. INST. C. E., F.S.I., 14, *North John Street, Liverpool.*

Reg. No.	Date of Election.	
[illegible]	1894. Mar.	**Parry**, William Kaye, ASSOC.M.INST.C.E., 35, *Dame Street, Dublin.*
900	1894. Jan.	**Rea**, John Todd, 2, *Llanion Terrace, Pembroke Dock, Pembroke.*
901	1894. Jan.	**Schorstein**, Gustave, M.A., M.D. (OXON.), M.R.C.P., D.P.H., 11, *Portland Place, W.*
[illegible]	1894. Jan.	†**Seward**, William B., 35, *Benhill Road, Camberwell, S.E.*
807	1894. Feb.	**Silk**, Albert Edward, ASSOC.M.INST.C.E., *c/o Messrs. King, Hamilton & Co., 7, Hare Street, Calcutta, India.*
902	1894. Jan.	**Stokes**, Frank, F.A.I., 49, *Upper Baker Street, N.W. (77, Welbeck St., W.).*
915	1894. Mar.	**Warry**, John King, M.D., D.P.H., M.O.H., *Town Hall, Hackney, N.E.* (24, *South Hill Park, Hampstead Heath, N.W*).
[illegible]	1894. Jan.	†‡**Willis**, Edward, 124, *High Street, Eton College, Bucks.*

ASSOCIATES (Assoc. San. Inst.)

‡ Passed Examination as Inspector of Nuisances.

Reg. No.	Date of Election.	
[illegible]	1894. Mar.	‡**Addison**, Scott, 15, *Mostyn Road, Bow, E.*
[illegible]	1894. Jan.	‡**Aubin**, Percy Adrian, 29, *St. James Street, St. Heliers, Jersey.*
843	1894. Feb.	‡**Balfour**, Alexander, 178a, *High Road, Kilburn, N.W.*
[illegible]	1894. Mar.	‡**Barker**, Frederick, 5, *Lawrence Street, Stockton-on-Tees, Durham.*
844	1894. Feb.	‡**Barker**, George Forster, 68, *Hillier Road, Wandsworth Common, S.W.*
845	1894. Feb.	‡**Barton**, James Henry, 14, *Young's Rd., Folkestone, Kent.*
846	1894. Feb.	‡**Blackburn**, Thomas, 26, *Devonshire Place, Brighton, Sussex.*
[illegible]	1894. Mar.	‡**Blowfield**, Ernest Frederick, 3, *Camberwell Station Road, S.E.*
847	1894. Feb.	‡**Boden**, Walter John, 133, *Finchley Road, N.W.*
[illegible]	1894. Mar.	‡**Bromley**, James, *Rothwell Estate Office, Sharples Hall. Bolton. Lancashire.*
[illegible]	1894. Feb.	‡**Budden**, Alexander, Junr., *Mission House, Larch Road, Balham, S.W.*
850	1894. Feb.	‡**Burrington**, Thomas Madge, *Prospect Place, Swindon, Wilts.*
903	1894. Mar.	‡**Cass**, Thomas Foley, 6, *Lansdowne Street, Hull, Yorkshire.*
851	1894. Feb.	‡**Catterall**, James Lamb, 270, *Vauxhall Bridge Road, Pimlico, S.W.*
905	1394. Mar.	‡**Chapman**, Cecil R. W., 5, *Carshalton Road, New Lakenham, Norwich.*

Reg. No. Date of Election.

883 1894. Mar. ‡Collett, Henry Herbert, 77, *Myrdle Street, Commercial Road, E.*

852 1894. Feb. ‡Cook, Joseph, 20, *Gowan Avenue, Fulham, S.W.*

853 1894. Feb. ‡Cook, William, 7, *Duddon Road, Askam-in-Furness, Lancashire.*

884 1894. Mar. ‡Coupe, Edward, 14, *Royle Road, Chorley, Lancashire.*

830 1894. Jan. ‡Cox, Charles, *Sanitary Inspector, Vestry Hall, Mile End, E.*

885 1894. Mar. ‡Crathorn, Joseph, *Gordon Street, Garrison Lane, Birmingham.*

854 1894. Feb. ‡Curd, Albert E., 24, *David's Road, Forest Hill, S.E.*

904 1894. Mar. ‡Curtin, William H., 12, *Studley Avenue, Holderness Road, Hull.*

906 1894. Mar. ‡Curtis, James, *Court House, Marylebone, W.*

855 1894. Feb. ‡Davies, Albert John, 154, *Severn Road, Cardiff.*

886 1894. Mar. ‡Deane, Miss Lucy Anne Evelyn, 100, *Fulham Road, South Kensington, S.W.*

887 1894. Mar. ‡Drake, Frederic, 7, *Walton Terrace, Hanwell, Middlesex.*

831 1894. Jan. ‡Dunbar, Miss Margaret, 41, *Great Coram Street, W.C.*

832 1894. Jan. ‡Dunn, Miss Lottie Elizabeth, *Kelfield Lodge, York.*

833 1894. Jan. ‡Edwards, William, 24, *Craven Street, Charing Cross, W.C.*

888 1894. Mar. ‡Egglestone, Wm. Morley, *Stanhope, Darlington, Durham.*

889 1894. Mar. ‡Elletson, John Malam, 131, *Tachbrook Street, S.W.*

856 1894. Feb. ‡Fillis, Edgar, 3, *Chester Terrace, Brighton, Sussex.*

857 1894. Feb. ‡Fowles, Joseph H., 13 & 15, *Hornby Street, Heywood, Lancashire.*

858 1894. Feb. ‡Gooderham, Francis F., *Corporation Depôt, Estcourt Road, Great Yarmouth.*

907 1894. Mar. ‡Grice, Malcolm, 8, *Albert St., Regent's Park, N.W.*

838 1894. Feb. ‡Hall, James William Wharton, 34, *St. Julian's Road, Kilburn, N.W.*

908 1894. Mar. ‡Hargreaves, John E., 53, *Berry Street, Burnley, Lancashire.*

840 1894. Jan. Harrison, George, Jun., 9, *Russell Gardens, Holland Road, Kensington, W.*

859 1894. Feb. ‡Henley, Sidney Herbert, 22, *Grosvenor Road, Richmond, Surrey.*

919 1894. Mar. Holes, John, 267, *Tonge Moor Road, Tonge, Bolton, Lancashire.*

890 1894. Mar. ‡Howes, Ernest, 19, *Flint Street, Walworth, S.E.*

891 1894. Mar. ‡Hutton, Albert Edward, 38, *Swamp, Queensbury, Yorkshire.*

861 1894. Feb. ‡Jackson, Thomas Henry, 1, *Badsworth Road, Camberwell, S.E.*

860 1894. Feb. ‡Jordan, Edward T. D., 191, *Hoe Street, North Walthamstow, Essex.*

Reg. No. Date of Election.

892 1894. Mar. ‡Kendall, Alan, 46, *Sefton Street, Southport, Lancashire.*

862 1894. Feb. ‡Knappett, Benjamin Albert, *East View, New Road, Weybridge, Surrey.*

866 1894. Feb. ‡Lill, George Davey, 167, *Brunswick Road, Poplar, E.*

867 1894. Feb. ‡Lillie, Edward John, 97, *St. John's Wood Terrace, N.W.*

833 1894. Jan. ‡Lyon, Frederic H., 6, *Grafton Street, Mile End, E.*

865 1894. Feb. ‡Marks, Charles William, 27, *Shaftesbury Street, Eccles, Lancashire.*

863 1894. Feb. ‡Marshall, John, *Rural Sanitary Authority, Hornby, Lancashire.*

920 1894. Mar. ‡Martin, Henry Richard, *Essendine Road, Caterham, Surrey.*

869 1894. Feb. ‡May, William John, F.R.G.S., F.S.SC., 29, *Sandringham Road, Dalston, N.*

870 1894. Feb. ‡Millard, William, 1, *Holmes Place, Fulham Road, S.W.*

864 1894. Feb. ‡Milton, John, 47, *Mount Row, Berkeley Square, W.*

[illegible] 1894. Jan. ‡Moffatt, Miss Sidney L. Paget, *Holy Trinity Vicarage, Blackburn, Lancashire.*

871 1894. Feb. ‡Moore, Charles, *Sanitary Inspector, Wrexham, Denbigh, N. Wales.*

835 1894. Jan. ‡Morgan, Forbes. 62, *Camden Street, N.W.*

841 1894. Jan. ‡Muse, John Gill, 27, *North Hamilton Street, Kilmarnock, Ayrshire.*

909 1894. Mar. ‡O'Connor, James, *Coombes Croft House, High Road, Tottenham, N.*

910 1894. Mar. ‡Orkney, Wm. Carnegie, *Moncrieffe, Bridge of Earn, Perth, N.B.*

873 1894. Feb. ‡Parslow, Charles James, 39, *Linver Road, Fulham, S.W.*

893 1894. Mar. ‡Plested, Horace Thomas, 6, *Emily Terrace, Putney, S.W.*

894 1894. Mar. ‡Plumer, Walter, 14, *Kennington Grove, S.E.*

895 1894. Mar. ‡Prince, Stephen Ernest, 37, *Warwick Street, Rotherham, Yorkshire.*

872 1894. Feb. ‡Puzey, Frederick, 187, *Brighton Rd., Croydon, S.W.*

896 1894. Mar. ‡Rapson, Thomas Henry, 28, *Poynings Road. Upper Holloway, N.*

874 1894. Feb. ‡Reid, William John, 99, *Bradbury Place, Belfast.*

911 1894. Mar. ‡Rickett, George, *Roxburgh House, Westgate-on-Sea, Kent.*

912 1894. Mar. ‡Riggs, John Wm., 17, *St. Leonard's Terrace, Newton Abbot, Devonshire.*

836 1894. Jan. ‡Robson, Charles, 3, *Chirton Road, North Shields, Northumberland.*

913 1894. Mar. ‡Romeril, Wm. George, 20, *Burnley Street, Greenwich, S.E.*

Reg. No.	Date of Election.	
897	1894. Mar.	‡Rouse, Francis James, STUD.INST.C.E., 3, *Manor Way, Blackheath, S.E.*
914	1894. Mar.	‡Rugg, Hugh Daniel, 22, *Woodstock Road, Poplar, E.*
915	1894. Mar.	‡Salmon, James, *District Sanitary Inspector, Glasgow, N.B.*
875	1894. Feb.	Scales, Alfred, 29, *Hertingfordbury Road, Hertford, Herts.*
916	1894. Mar.	‡Scarfe, Roland, 19, *The Chase, Clapham Common, S.W.*
898	1894. Mar.	‡Spears, Henry Horatio, 28, *Shakespeare Road, Northampton.*
917	1894. Mar.	‡Smith, James, 7, *Park Street, Macclesfield, Cheshire.*
865	1894. Feb.	‡Swinnock, William James, 218, *Sultan Road, Landport, Hampshire.*
876	1894. Feb.	Thomas, Henry, *Town Hall, Spa Road, S.E.* (78, *Southwark Park Road, S.W.*)
837	1894. Jan.	‡Turnbull, Frederick R., 24, *York Street, West Hartlepool, Durham.*
899	1894. Mar.	‡Walker, James Edward, *Vine Cottage, Hunstanton, St. Edmunds, Norfolk.*
877	1894. Feb.	‡Wallis, Francis F., *Town Hall, Swanage.*
900	1894. Mar.	‡Waugh, Matthew, *Hexham, Northumberland.*
835	1894. Jan.	‡Way, William, 159, *Hartfield Road, Wimbledon, S.W.*
874	1894. Feb.	West, William Washington, 3, *Henrietta Villas, Lower Road, & Town Hall, Walthamstow, Essex*
901	1894. Mar.	‡White, Frank, 38, *Maple Street, Northampton.*
842	1894. Jan.	‡Wilson, Marmaduke Temple, 69, *Narrowgate, Alnwick, Northumberland.*
918	1894. Mar.	‡Wolters, Wm. John, 62, *Huntingdon Street, Barnsbury N.*
902	1894. Mar.	‡Young, Thomas, *Local Board Office, Blaydon-on-Tyne, Durham.*

OBITUARY.

INSPECTOR-GENERAL ROBERT LAWSON, LL.D., Q.H.P.

Inspector-General Lawson died on Feb. 8th, 1894, at Aberdeen, at the age of 79. He was born in 1815. At the age of 20 he was appointed Assistant-Surgeon in the Army, and served in the West Indies, the West Coast of Africa, Cape Colony, and in the Hospital at Scutari during the Crimean War. In 1867 he received the rank of Inspector-General of Hospitals (a title which is now obsolete), and retired from the Army in 1872.

After his retirement Inspector-General Lawson acted on several Commissions. He received the degree of LL.D. from the University of Aberdeen in 1884, and was appointed Hon. Physician to the Queen in 1891.

He took a great interest in Meteorology and in the study of the progress of epidemic diseases, especially Cholera. He was also an active sanitary reformer, and his zeal in carrying out preventive measures in the Crimea brought him into collision with the authorities.

Inspector-General Lawson was a member of The Sanitary Institute and of the Parkes Museum for many years before their amalgamation, and afterwards became Treasurer of the Institute in succession to Lord Braye. He devoted much time to the interests of the Institute, until failing health compelled him to resign the Treasurership in August, 1893. His loss was much regretted by the Council and by all who came in contact with him.

He was buried in Nellfield Cemetery at Aberdeen on February 12th.

E. W. W.

CONTRIBUTIONS AND ADDITIONS TO LIBRARY.

January to March, 1894.

⁂ *For publications of Societies and Institutions, &c., see under "Academies."*

ACADEMIES (American).

Manitoba. *Historical and Scientific Society.* The Social Customs and Amusements in the early days in the Red River Settlement and Ruperts Land. By J. McBeth. 7 p., 8vo. Winnipeg, 1893. *The Society.*

—— *Historical and Scientific Society.* Annual Report for the year 1892. 23 p., 8vo. Winnipeg, 1893. *The Society.*

Ontario. *Association of Executive Health Officers.* Report of the Eighth Annual Meeting held at Guelph June 27th and 28th, 1893. 175 p., 8vo. Toronto, 1894. *The Association.*

(Australian).

Melbourne. *Australian Health Society.* Eighteenth Annual Report for 1892-3. 16 p., 8vo. Melbourne, 1893. *The Society.*

(Continental).

Roma. *R. Università di.* Annali dell' Istituto d' Igiene Sperimentale. Vol. III. (nuova Serie). Fasc. III. and IV. 330 p., 8vo. Roma, 1893. *Prof. A. Celli.*

Army Medical Department. Reports for the years 1887—91. Vol. XXIX., 391 p., 8vo., London, 1889. Vol. XXX., 411 p., 8vo., London, 1890. Vol. XXXI., 449 p., 8vo., London, 1891. Vol. XXXII., 391 p., 8vo., London, 1892. Vol. XXXIII., 402 p., 8vo., London, 1893. *Director-General W. A. Mackinnon.*

Birkenhead. *Borough of.* A short description of the Co-operation Hospital for Infectious Diseases. 10 p., 8vo. Birkenhead, 1894. *C. Brownridge.*

Board of Agriculture. Agricultural Returns of Great Britain, with Abstract Returns for the United Kingdom, British Possessions and Foreign Countries, 1893. 184 p., 8vo. London, 1893. *The Board.*

Brighton Public Art Gallery. Report for the year 1891-2. 10 p., 8vo. Brighton, 1892.

Brighton Public Museum. Report for the year 1893. 24 p., 8vo. Brighton, 1893.

Chalmers, *Dr. A. K.* Scarlatina and Scarlatinal Sore Throat. A record of Milk Infection. 15 p., 8vo. Glasgow, 1894. *The Author.*

Contagious Diseases Acts (Animals) and Orders of Council. Handbook. 854 p., 8 vo. London, 1887. *Purchased.*

Everett, *J. D.* Outlines of Natural Philosophy. 368 p., 16mo. London, 1888. *Purchased.*

Flower, *Major Lamorock.* The River Lea "Up to date." 39 p., 8vo. London, 1893. *The Author.*

Fulleylove, *W. K.* The Portable Turkish Bath. 13 p., 8vo. *The Author.*

Galvao, *Dr. Rodolpho.* Relatorio Apresentado e Fevereiro do corrente anno ao Sr Governandor do Estado. 42 p., 8vo. Recife, 1893.

Goslett, *Clare.* Influenza and how to go through it. 16 p., 8vo. London, 1892. *The Author.*

Home Office Departmental Committees. Report from the Committee on the various Lead Industries. 25 p., f.cap. London, 1893. *Purchased.*

——— Report on the Conditions of Labour in Potteries, the Injurious Effects upon the Health of the Workpeople and the Proposed Remedies by the Potteries Committee of Inquiry. 24 p., f.cap. London, 1893. *Purchased.*

——— Report on the Conditions of Labour in Chemical Works, the Dangers to Life and Health of the Workpeople employed therein, and the Proposed Remedies. 29 p., f.cap. London, 1893. *Purchased.*

——— Report by the Chemical Works Committee of Inquiry. 5 p., f.cap. London, 1893. *Purchased.*

Local Government Board. Dr. Bruce Low's Report on the Circumstances of the River Trent in Lincolnshire and part of Nottinghamshire, with Special Reference to the Water Supplies of Populations resident on or near the Banks of the River, and to the occurrence amongst those populations of Enteric Fever. 44 p., f.cap. London, 1893. *The Board.*

Local Government Board. Dr. Wheaton's Report on an Outbreak of Enteric Fever in the Town of Atherstone. 12 p., f.cap. London, 1893. *The Board.*

—— Model By-Laws No. 9, issued for the use of Sanitary Authorities. 51 p., 8vo. London, 1893. *Purchased.*

—— Dr. Monckton Copeman's Report upon the Sanitary Condition of the Village of Thorpe, St. Andrew in the Blofield Rural Sanitary District. 20 p., 8vo. London, 1894. *The Board.*

—— Dr. Sweeting's Report on the Circumstances Attending Recent Prevalence of Fatal Diphtheria in the Alton Registration Sub-District, Hants. 8 p., f.cap. London, 1893. *The Board.*

—— Dr. S. W. Wheaton's Report on the Prevalence of "Fever" in the Urban District of Aston-in-Makerfield. 10 p., f.cap. London, 1894. *The Board.*

London County Council. Reports on Sewer Air. Investigations by J. Parry Laws, F.I.C. 15 p., f.cap. London, 1893. *The Council.*

MEDICAL OFFICERS' REPORTS.

Torquay	for the year 1893.	*P. Q. Karkeek.*
Whitechapel ..	" "	*J. Loane.*
River Tyne Port Sanitary Authority ..	" "	*H. E. Armstrong.*
Roxburgh County Council, 1892.		*A. Morris.*

Metropolitan Water Supply, *Royal Commission on.* Report of the Royal Commission appointed to inquire into the Water Supply of the Metropolis. 72 p., f.cap. London, 1893. *Purchased.*

—— *Royal Commission on.* Appendices to Minutes taken before the Royal Commission. 692 p., f.cap. London, 1893. *Purchased.*

—— *Royal Commission on.* Minutes of Evidence. 555 p., f.cap. London, 1893. *Purchased.*

—— *Royal Commission on.* General Index to the Report. Minutes of Evidence and Appendices. 39 p., f.cap. London, 1893. *Purchased.*

Model By-Laws under the Public Health Amendment Act, 1890. 50 p., 8vo. London, 1893. *Purchased.*

Museums' Association. Report of Proceedings, with the Papers read, at the Fourth Annual General Meeting, held in London, July 3rd to 7th, 1893. 140 p., 8vo. York and Sheffield, 1893. *The Association.*

New York. *State Board of Health.* Twelfth Annual Report for the year 1891. 558 p., 8vo. Albany, 1892. *The Board.*

—— *State Board of Health.* Thirteenth Annual Report for the year 1892. 736 p., 8vo. Albany, 1893. (8vo Vol. of maps accompanying). *The Board.*

Nottingham. The Meteorology of, for the year 1893. 6 p., f.cap. (map). Nottingham, 1893. *P. Boobyear.*

Ottawa. *Inland Revenue Department.* Laboratory of Inland Revenue Department, Ottawa, Canada. Bulletin, No. 34. "Alcoholic Tinctures." 19 p., 8vo. *The Department.*

Parkes, *Dr. Louis.* Infectious Diseases—Notification and Prevention. 185 p., 8vo. London, 1894. *The Author.*

Patent Office. *Abridgements of Specifications (Period* 1877—1883) *Relating to.* Acids, Alkalies, Oxides and Salts, Electricity and Magnetism, Metals and Alloys, Manufacture of Iron and Steel, Wearing Apparel, Fire Extinction, Gas Manufacture, Hydraulic Engineering, Building and Structures, Grinding and Burnishing, Beverages, Bleaching and Dyeing, Cooking and Kitchen Appliances, Cements and like Compositions, &c.

——— *Appendices to, Un-illustrated.* Division I., Firearms and Similar Weapons. Division I., Head Coverings. Division II., Cartridges, Projectiles, and Explosives. Division II., Body Coverings. Division III., Foot Coverings. Division IV., Dress Fastenings and Jewellery. Photography, Sewing, and Embroidering. Preparing and Cutting Cork, Bottling Liquids, Securing and Opening Bottles, and the like. *H.M. Patent Office.*

Registrar-General. *Ireland.* Twenty-ninth Detailed Anuual Report containing general abstract of numbers of Marriages, Births, and Deaths in Ireland during 1892. 193 p., f.cap. Dublin, 1893. *Registrar-General.*

——— *Scotland.* Thirty-Seventh Detailed Annual Report of Births, Deaths, and Marriages, 1891. 459 p., 8vo. Edinburgh, 1893. *Registrar-General.*

Rome. Nuovo methodo analisi delle materie coloranti artificiali derivate dal catrame del Dott Giovanni Rota. 28 p., f.cap. Roma, 1893. *Ministero dell' Interno.*

——— L'Azione del suolo sui Germi del carbonchio: studio critico-sperimentale del Dott F. Rolando. 36 p., f.cap. Roma, 1892. *Ministero dell' Interno.*

——— Contributo allo studio della tossicatà dello spirillo colerigeno (Massaua-Ghinda) dei dottori F. Inghilleri e F. Rolando. 22 p., f. cap. Roma, 1893. *Ministero dell' Interno.*

——— Sulle Funzioni reciproche dei sali inorganici nella inanizione minerale e nelle malattie consuntive per il Dott Giuseppe Sanarelli. 29 p., f.cap. Roma, 1893. *Ministero dell' Interno.*

Sanitary Record Diary for 1894. 150 p., 8vo. London, 1893. *The Editor.*

Scott, *Robert H.* Elementary Meteorology. 410 p., 8vo. London, 1893. *Purchased.*

Stewart, *Prof. Balfour.* Physics. 170 p., 16mo. London, 1891. *Purchased.*

Stockport, *Borough of.* Information from various Towns respecting House Drainage, &c. 32 p., f.cap. Stockport, 1894. *J. Atkinson.*

Truman, *Mary, and* **Sykes,** *Edith.* Disinfection. 27 p., 8vo. London. *Miss Sykes.*

——— Food for the Sick. 52 p., 8vo. London. *Miss Sykes.*

United States Army. Index Catalogue of the Library of the Surgeon-General's Office. Vol. XIV., Sutures—Universally. 1016 p., 4to. Washington, 1893. *Surgeon-General, U. S. Army.*

Wood, *Dr. W. A.* Animals a cause of Scarlet Fever and Diphtheria. 4 p., 8vo. *Australian Health Society.*

Worthington, *T. Locke.* Dwellings of the People. 164 p., 8vo. London, 1893. *Purchased.*

MEETINGS HELD DURING JAN. TO MARCH, 1894.

SESSIONAL MEETINGS

of the Institute were held on January 10th, when an address was delivered by R. Thorne Thorne, C.B., F.R.S., on "The Etiology, Spread, and Prevention of Diphtheria" (see page 7), and on February 14th, a paper was read by F. J. Waldo, M.A., M.D., on "The Sanitation of Places where Food is Stored and Prepared" (see page 21). About 140 Members, Associates, and Visitors attended each meeting.

THE SEVENTH COURSE OF LECTURES

on Domestic Hygiene specially intended for Ladies was given by A. T. Schofield, M.D., M.R.C.S., on March 2nd, 6th, 9th, and 13th, the subjects were "Modern Hygiene, Practice in Infancy, in Childhood, in Adolesence, in Maturity, and Decay." Her Royal Highness The Duchess of Albany attended three of the Lectures, and there was an average of 130 Ladies present at each Lecture.

LECTURES AND DEMONSTRATIONS TO SANITARY OFFICERS, LONDON.

The Seventh Course consisting of 18 Lectures and 16 Practical Demonstrations, and Visits of Inspection to Trade Premises, Refuse Disposal Works, &c., commenced on January 26th, and ended on April 2nd, 130 Students entered their names for this Course.

NOTTINGHAM.

The Lectures in connection with the Nottingham County Council and Nottingham County Borough were concluded on February 17th. Over 60 Candidates entered their names for this course. Several Visits of Inspection were also made in connection with these Lectures.

EXAMINATION.

At an Examination for Inspectors of Nuisances, held at the University College, Nottingham, on March 16th and 17th, 33 Candidates presented themselves. Questions were set to be answered in writing on the 16th, and the Candidates were examined *vivâ voce* on the 17th. 19 Candidates were certified to be competent, as regards their Sanitary knowledge, to discharge the duties of Inspector of Nuisances.

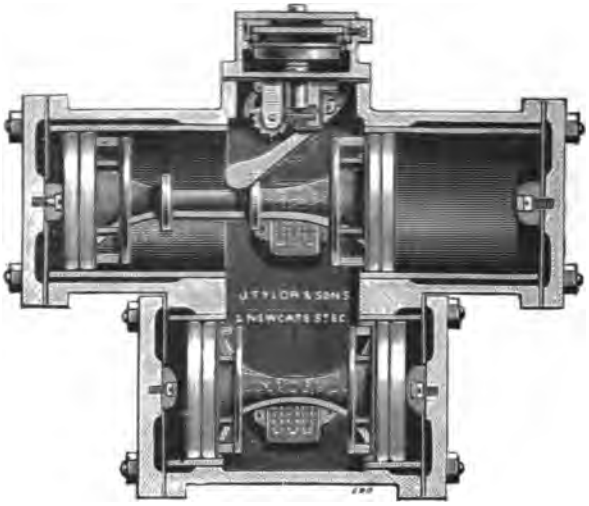
The Chairman of the Sanitary Committee and the Medical Officer of Health to the Town Council of Nottingham attended the Examination as visitors.

Exhibits selected for further practical trial at the Exhibitions of the Institute to which Awards have been made since the publication of last list.

Positive Water Meter.

Certificate of Merit.

To J. Tylor & Sons.



Description.—The Meter consists of a cast-iron casing, containing four cylinders lined with gun-metal, and open to the central water chamber. The pistons working in these cylinders are free to turn on their axes, and consequently take up the position of least friction. Each piston is provided with cup leathers, accessible and removable by loosening the plates at ends of Meter. The pistons are coupled by a gun-metal rigid connection. Each pair of pistons in its turn actuates the valve of the other pair in such a manner that no dead point occurs, and the movement of both pistons and valves is free and uncontrolled by guides, stuffing-boxes or bearings. The valves of the Meter, kept on their faces by the pressure of the water, are of the ordinary 3-port class, and are interchangeable without adjusting or removing other parts of the Meter.

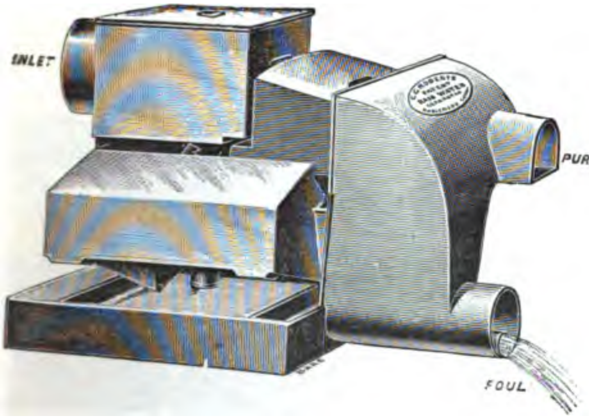
Sizes.—	⅜ in.	½ in.	¾ in.	1 in.
Prices.—	£3 13s. 6d.	£5	£7 7s.	£10 10s.

Manufactured by J. Tylor & Sons, Limited, 2, Newgate Street, E.C.

Horizontal Rain Water Separator.

Medal.

To C. G. Roberts.



Description.—The Horizontal Separator is made of zinc upon an iron frame. It consists of a fixed head that receives the water, and a fixed outlet box, with two delivery pipes for foul and pure water respectively. The canter, or third part of the Separator, is removable, and is balanced upon a pivot. A heavy weight on the back of the canter keeps the front of it usually lifted up in the position shown in figure. There are two open channels in the upper part of the canter. When the canter is *up*, the front channel directs the water that comes from the head into the (lower) foul water delivery pipe; when the canter is *down*, the back channel directs the water into the (upper) pure water delivery pipe.

Sizes.—Area of Roof in feet: In the Country—No. 2, 600 to 1,100; No. 4, 1,101 to 3,000; No. 6, 3,001 to 5,000. In the City or Tropics—No. 4, 730 to 2,000; No. 6, 2,000 to 3,300. Depth of Outlet pipes below level of Inlet pipe (see Figure): Pure Outlet—4½ in., 4¾ in., and 5 in. Foul Outlet—11 in., 12 in., and 13 in.

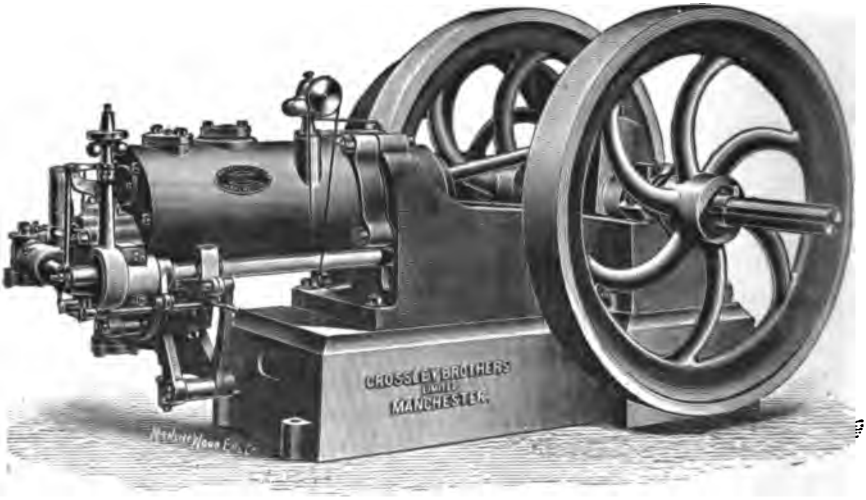
Prices on Rail at Haslemere.—£3, £4 10s., and £6.

Manufactured by C. G. Roberts, Haslemere, Surrey.

Horizontal Gas Engine.

Medal.

To Crossley Brothers.



Description.—The block represents one of the latest type, viz., a 20 h.-p. (nominal) Engine, fitted with Tube Ignition and Timing Valve, and Crossley's Safety Gear to prevent the Engine starting backwards.

Sizes.—From ½ h.-p. to 170 h.-p.

Prices.—½ h.-p. to 26·2 h.-p., £44 to £159. 33 h.-p. to 170 h.-p. on application.

Manufactured by Crossley Bros., Openshaw, Manchester.

A CONTRIBUTION TO A BIBLIOGRAPHY OF HYGIENE.

PREPARED BY G. J. SYMONS, F.R.S.

Although there is in the Library of The Sanitary Institute a "Dissertatio de Hygieine," published in 1710, it is rightly the custom to regard the study of Sanitation and Hygiene as originating in the early years of the reign of H.M. Queen Victoria. Since that date the reports, tracts, and pamphlets published upon the subject are to be reckoned by thousands, and even the larger works must number several hundreds. It would obviously be inconsistent with the scope of this Journal to attempt to give here more than a typical selection, but as it is intended that successive numbers shall contain lists of new publications it has been thought well to give in this first number the titles of some works already published.

Up to the present time the writer is not aware of any Catalogue or Bibliography of Works and Papers on Sanitation, except that of the Library of the International Health Exhibition, 1884. The greater portion of that Library was presented by H.M. Commissioners to the Parkes Museum, and being incorporated with that of The Sanitary Institute, the total Library is now in its own department probably unequalled, and it is extremely satisfactory to add that a complete catalogue of it is being prepared for publication.

In the interim it is hoped that the following list will be useful. It must be distinctly understood that in quoting a work there is not the slightest indication of any opinion, either by the Institute or by the writer, as to its merits, and *per contra* that the absence of any work in no way implies disapproval. It is impossible to make a list of this kind perfect, and doubtless the majority of readers will notice omissions. It will probably help the Institute to perfect its Library and its forthcoming Catalogue if readers will send lists of omissions to the Secretary. In compiling the following list the writer has quoted freely from the valuable catalogues of E. and F. N. Spon, of London and New York, W. H. Kühl, Jägerstrasse 73, Berlin W., of Franz Pietzcker, Tübingen, and of H. Welter, 59, Rue Bonaparte, Paris.

It will be noticed that the list does not contain either Acts of Parliament, Blue Books, or the Reports of Medical Officers. Of course this by no means ignores the valuable information which they contain; it is solely a question of space.

A list of periodicals will be given in the next number. Books in the Library of The Sanitary Institute are marked with a star.

The prices must be regarded as approximate only, but it has been thought better to give some indication upon the subject than none.

Adams, Julius W., *C.E.* Sewers and Drains for Populous Districts, with Rules and Formulæ for the determination of their dimensions. 1892. 8vo. 12/6

***Albrecht, Dr. M.** Bericht der Gesundheits-Commission für den Bezirk Uhlenhorst über ihre Thätigteit während der Cholera-Epidemie, 1892. 8 pp. (tables), 4to. Hamburg, 1893.

***Allan, Dr. F. J.** Aids to Sanitary Science. 236 pp., 16mo. London, 1890.

Altmann, R. die Elementarorganismen und ihre Beziehungen zu der Zellen. 2 Aufl., 8vo. Leipzig, 1890. 32/-

***Arlidge, Dr. J. T.** The Hygiene, Diseases and Mortality of Occupations. 568 pp., 8vo. London, 1892.

*——— Pottery Manufacture in its Sanitary Aspects. 18 p., 16mo. Hanley, 1893.

***Armstrong, H. E.** (*See* Stevenson.)

***Ashby, A.** (*See* Stevenson.)

Baas, J. H. Gesundheit und langes Leben. Ein hygieinische Hausbuch. Leipzig. 5/-

Baer. (*See* Pettenkofer.)

Baker, M. N. (*See* Rafter and Baker.)

Baldwin, W J., *Mem. Am. Soc. C.E.* Hot-water Heating and Fitting, or Warming Buildings by Hot Water. Illustrations. 8vo. 1890. 20/-

——— Steam Heating for Buildings, or Hints to Steam Fitters, being a description of Steam Heating Apparatus for Warming and Ventilating Private Houses and Large Buildings. With illustrations. Crown 8vo. 1893. 10/6

***Ballard, E.**, *M.D.* Report on Effluvium Nuisances.

Battershall, J. P., *Ph.D.*, *F.C.S.*, *Chemist U.S. Laboratory, New York City.* Food Adulteration and its Detection, with Photomicrographic plates and a Bibliographical Appendix. Demy 8vo. 1887. 15/-

Baumeister, E., *Professor at the Technical Institute of Carlsruhe.* The Cleaning and Sewerage of Cities. Adapted from the German with permission of the Author. By J. M. Goodell. 8vo. 1891. 12/6

---

* In Library of Institute.

***Bayard, F. C.** English Climatology, 1881—1890. 23 pp., 8vo. *Excerpt Quarterly Journal of Royal Meteorological Society, Oct.,* 1892.

***Bernan.** History and Art of Warming and Ventilating. Vols. 1 & 2. 8vo. London, 1845.

Bevan, D., and Coplin, W. M. L. A manual of Practical Hygiene. 8vo. Illustrated. 1894. 18/-

Billroth, T. The Care of the Sick at Home and in the Hospital; a Handbook for Families and for Nurses. 3rd Edition, 326 pp., post 8vo. London, 1890. 6/-

Birch, R. W. Peregrine, *C.E., F.G.S.* Sewage Irrigation by Farmers, or Fifty Instances of Profitable Sewage Utilization. 8vo. London, 1879. 2/6

***Blair, Dr. J. A.** The Organic Analysis of Potable Waters. 120 pp., 8vo. London, 1891.

***Blake, E. T.,** *M.D.* Sewage Poisoning, its Causes and Cure. London, 1879.

***Blyth, Prof. A. Wynter.** A Dictionary of Hygiene and Public Health. 8vo. London, 1876.

*——— A Manual of Public Health. 653 pp., 8vo. London, 1890.

*——— Lectures on Sanitary Law. 287 pp., 8vo. London, 1893.

***Booker, F.** Concerning Inspectors of Nuisances, their appointment, &c.

***Bouchardat, A.** Traité d'Hygiène publique et privée basèe sur l'étiologie. 1350 pp., 8vo. Paris, 1887.

***Boulnois, H. Percy,** *M.Inst.C.E.* Dirty Dustbins and Sloppy Streets; a practical treatise on the Scavenging and Cleansing of Cities and Towns. Crown 8vo. London and New York, 1881. 1/-

*——— The Municipal and Sanitary Engineers' Handbook. 2nd Edition. 445 pp., 8vo. London, 1892. 15/-

Boutin, A. Traitement du choléra au nouvel hôpital du Hâvre (épidémie de 1892). 4to. Paris, 1893. 1/-

Brightmore, A. W. (*See* Turner and Brightmore.)

Brix, J. (*See* Winter and Brix.)

Broom, Geo. J. C., *F.G.S., Assoc.Mem.Inst.C.E.* Drainage with regard to Health and Modes of Disposal of Town Sewage. 8vo. 1889. 2/-

***Brown, Oswald,** *Mem.Inst.C.E.* Rules and Regulations made under Adelaide Sewers Act (South Australia), 1878; also plans and descriptive directions as to the best method of making House Connections. 4to. London, 1882. 2/-

***Buchan, W. P.** Plumbing, House Drainage, and Ventilation. London, 1889.

*——— Ventilation. 226 pp., 8vo. London, 1891. 4/-

---

* In Library of Institute.

***Buckton, Mrs.** Our Dwellings: Healthy and Unhealthy. London, 1885.

*——— Health in the House. 14th Edition. 12mo. London, 1887.

***Burdett, H. C.** Pay Hospitals of the World. 8vo. London, 1879.

——— Cottage Hospitals. 2nd Edition. 8vo. London, 1880.

***Canalis, Dr. Pietro.** Note sulla epidemia colerica del 1887 nella citta di Messina. 24 pp., fol. Rome, 1889.

——— Studi sulla infezione Malarica, 32 pp., fol. Torino, 1889.

***Carnelley, Thomas.** Report on the Cost and Efficiency of the Heating and Ventilation of Schools, for the use of the School Board of Dundee.

***Carpenter, Dr. Alfred.** Sewage Farming. 23 pp., 8vo. *Excerpt Trans. International Congress of Hygiene and Demography*, 1891.

Cassel. Beschreibung der Garnison Cassel, vom Standpunkt der Gesundheitspflege aus aufgestellt. Mit 2 Karten, 56 Tafeln, und 1 Abbildung. Berlin, 1894. 8/-

***Chalmers, Dr. A. K.** Scarlatina and Scarlatinal Sore Throat: a Record of Milk Infection. 15 pp., 8vo. Glasgow, 1894.

Chapman, E. T. (*See* Wanklyn, J. A., and Chapman, E. T.).

***Chaumont, F. De,** *M.D., F.R.S.* (*See* Parkes.)

***Clarke, J. Wright.** Lectures to Plumbers. 270 pp., 4to. London, 1893.

Codrington, T., *M.Inst.C.E.* Maintenance of Macadamised Roads.

***Collins, H. H.,** *F.R.I.B.A.* Sanitation as an Increment of value in House Property.

*——— Hints on Home Sanitation.

***Colyer, F.,** *M.Inst.C.E.* Public Institutions: their Engineering, Sanitary, and other Appliances. 219 pp., 8vo. London, 1889.

*——— Treatise on Water Supply, Drainage, and Sanitary Appliances of Residences. 92 pp., 8vo. London, 1889.

——— Modern Sanitary Appliances for Healthy Residences and Public Institutions. Crown 8vo. 1892. 5/-

***Contagious** Diseases (Animals) Acts and Orders of Council. Handbook. 8vo. London, 1887.

***Copeman, S. M.** (*See* Stevenson.)

Coplin, W. M. L. (*See* Bevan.)

***Corfield, Prof. W. H.** Health. 8vo. London, 1880.

*——— The Laws of Health. 2nd Edition. 8vo. London, 1883.

*——— The Treatment and Utilization of Sewage. 3rd Edition. 8vo. London, 1887.

*——— Dwelling Houses: their Sanitary Construction and Arrangements. 3rd Edit. 128 pp., Post 8vo. Illustrations. 1894. 3/6

*——— Sanitary Fallacies.

*——— (*See* Stevenson.)

Cornet, Dr. G. Ueber Tuberculose. Die verbreitung der tuberkelbacillen ausserhalb des Körpers. 8vo. Leipzig. 4/-

---

* In Library of Institute.

Creighton, Dr. C. A history of epidemics in Britain from A.D. 664, to the extinction of the Plague. 8vo. Cambridge, 1891.

***Crimp, W. Santo,** *M.Inst.C.E.* Sewage Disposal Works. 277 pp., 8vo. London, 1890.

Crookes, W., *F.R.S.* Methods of Practical Hygiene, by Professor Lehmann. Illustrations. 2 vols. 8vo. London, 1893.

Dechambre. (*See* Rossignol and Dechambre.)

Degen. (*See* Pettenkofer.)

Degener, P. die Forderungen der Hygiene an die Beseitigung städt. Kanalwässer durch Berieselung. Frankfurt, 1894. 1/-

Denton, J. Bailey, *M.Inst.C.E.* Ten years' experience in works of Intermittent downward Filtration. 2nd Edition, with additions. Royal 8vo. London, 1885. 5/-

De Rance, C. E., *C.E., F.G.S.* The Water Supply of England and Wales. Illustrations. 8vo. London, 1882. 10/-

***Druetti, Dott. G.** Sullo Stato Sanitario degli emigranti nelle traversate transatlantiche. 10 pp., fol. Rome, 1890.

***Drysdale, J.,** *M.D.*, and **Hayward, J. W.,** *M.D.* Health and Comfort in House building, or ventilation with warm air by self-acting suction, mode of calculating the draught in hot-air flues, and actual experiments. 3rd Edition. 8vo. Plates. London, 1876.

***Dukes, Dr. Clement.** The Preservation of Health. 222 pp., 8vo. London, 1883.

*——— The Essentials of School Diet. 187 pp., 8vo. London, 1891.

***Dye, F.** (*See* Hood, C.)

Eassie, W. Sanitary arrangements for Dwellings. 8vo. London, 1874.

***Edwards, F.** Our Domestic Fire Places. 8vo. London, 1865.

*——— On the Ventilation of Dwelling Houses 8vo. 2nd Edition. London, 1868.

***Eminson, T. B. Franklin.** Epidemic Pneumonia at Scotter and neighbourhood: its history, causes, and future prevention. 66 pp., 16mo. London, 1892.

Emmerich, R. und **Trillich, H.** Anleitung zur hygienische Untersuchungen, etc. 8vo. 1889.

Engel Bey, Fr. die Influenza-Epidemie in Egypten im Winter 1889–90. Nebst einem Anhang über: die Influenza-Epidemie ebendaselbst im Winter 1891-92. 4to. Berlin, 1893. 4/-

Erismann, F. Gesundheitslehre. 3 Auflage. 8vo. 1885. 3/-

——— (*See* Pettenkofer.)

Fanning, J. T., *C.E.* A Practical Treatise on Water Supply Engineering, Hydrology, Hydrodynamics, and practical construction of Waterworks in North America. 10th Edition, revised and enlarged. 8vo. Tables and Illustrations. 1892. 25/-

---

* In Library of Institute.

*__Farr, Dr. W.__, *C.B.*, *F.R.S.* Vital Statistics. Edited by Noel A. Humphreys. 8vo. London, 1885. 30/-

Faulkner, A. S. A Guide to the Public Medical Service. London, 1894. 2/-

*__Fazio, Dott. Eugenio.__ Influences climatériques et sanitaires des Forêts; dangers du déboisement. Communication faite a la IX. Congrès International de Médecine, 1887.

*——— Micro-organismi nei vegetali usati frexhi nell' alimentazione. 14 pp., 8vo. *Excerpt from "Reforma Medica," September, 1889.*

*——— Batterii dellé Acque minerali, loro importanza Biologica ed Igienica. 40 pp., 8vo. Naples, 1890.

Field, Rogers, *C.E.*, and **Haviland, A.**, *M.O.H.* The late visitation of Typhoid Fever in the School and Town of Uppingham. Small fol. 1876. 2/6

*——— Bye-Laws and Regulations with reference to House Drainage. 8vo. London, 1877. *Out of Print.*

*——— Practical Suggestions as to the Water Supply, Drainage, and Sewage Disposal of Lunatic Asylums, issued by the Commissioners in Lunacy. 17 pp., 8vo. London, 1892.

Finkelnbur, C. (*See* Weyl, T.)

*__Fitzgerald, Vesey.__ Public Health and Local Government Act, 1875.

Fleming, G. *C.B.*, *F.R.C.V.S.* A treatise on the Parasites and parasitic diseases of the Domesticated animals. 8vo. Illustrations. 1892.

*__Fletcher, Prof. Banister.__ Metropolitan Building Acts. 219 pp., 8vo. London, 1882.

*——— Quantities. 268 pp., 8vo. Plates. London, 1889.

Fluegge, C. Beiträge zu Hygiene. Leipzig, 1879. 5/-

——— Lehrbuch du hygienische Untersuchungsmethoden. Leipzig, 1881. 16/-

Fluegge, G. Grundriss d. Hygiene. 3 Aufl. 12/-

——— (*See* Pettenkofer.)

*__Fodor, Dr. Josef von.__ Hygienische Untersuchungen über Luft, Boden und Wasser. 2 vols. 140 pp. and 378 pp., 8vo. Diagrams. Braunchsweig, 1882. 15/-

——— (*See* also Weyl, T.)

Folkard, C. W. Potable Water and the different methods of detecting impurities. 18mo. 1882. 2/-

Forster. (*See* Pettenkofer.)

*__Fox, Dr. Cornelius B.__ The Disposal of the Slop Water of Villages. 2nd Edition. 8vo. London, 1877.

——— Sanitary Examinations of Water, Air, and Food. Plates. 8vo. London, 1878.

Frankland, Prof. E., *F.R.S.* Water Analysis for Sanitary Purposes. 8vo. London, 1880.

---

* In Library of Institute.

***Freeman, M.**, and **S. E.** Disinfection. 37 pp., 8vo. London.

*——— Food. 52 pp., 8vo. London.

***Galton, Capt. Douglas**, *R.E.*, *K.C.B.* Observations on the Construction of Healthy Dwellings; Houses, Hospitals, Barracks, Asylums, &c. 8vo. Oxford, 1880.

*——— Ventilation, Warming, and Lighting for Domestic Use. 8vo. London, 1884. *From Health Exhibition Literature.*

*——— Cremation. 6 pp., 8vo. London, 1893. An Address delivered at the meeting of the Church Congress, Birmingham, October, 1893.

*——— Healthy Hospitals, Observations on some points connected with Hospital Construction. 287 pp., 8vo. Oxford and London, 1893.

*——— Report on the works of Sewerage and Drainage proposed for the town of Cannes.

***Garrett, E.** The Law of Nuisances. 548 pp., 8vo. London, 1890.

Gasquet Dr. F. A., *O.S.B.* The Great Pestilence (A.D. 1348-9), now commonly known as The Black Death. 8vo. London, 1893.

Geigel. (*See* Pettenkofer.)

***Gerhard, W. Paul**, *C.E.* House Drainage and Sanitary Plumbing. 18mo. New York, 1882. 2/-

*——— Hints on the Drainage and Sewerage of Dwellings. Engravings. Crown 8vo. London and New York, 1884. 10/6

——— The Disposal of Household Wastes; the best methods of treatment of the Sewage of Farm-Houses, small Towns, Hospitals, &c., and removal and disposal of Garbage, Ashes, and other solid House refuse. 18mo. 1890. 2/-

*——— A Guide to Sanitary House Inspection, or hints and helps regarding the choice of a healthful home in City or Country. Square 16mo. 1890. 6/-

Gerson, G. Verunreinigung der Wasserläufe durch die Abflusswässer. Berlin, 1889.

***Gillespie, Rev. C. G. K.** The Claims of Sanitary Science upon the Clergy. 23 pp., 8vo. London, 1891.

***Glen, W. C.**, **Q.C.** The Law relating to Public Health. 12mo. London, 1858.

Goodell, J. M. (*See* Baumeister.)

***Gordon, J.** Bericht über die Canalization des Schleussengrabens der Stadt Ludwigshafen.

*——— Canalization der Stadt Heilbronn.

*——— Die Canalization der Kgl. Haupt und Reisidenzstadt München. München, 1876.

*——— Stenographischer Bericht über das Gutachten des Herrn Ingenieur J. Gordon aus Frankfurt a.m. hinsichtlich der Canalizationsfrage in Nürnberg.

---

* In Library of Institute.

***Goslett, C.** Influenza and how to go through it. 16 pp., 8vo. London, 1892.

Grahn, E. Die Art der Wasserversorgung der Städte der deutschen Reiches mit mehr als 5000 Einwohnern. München. 1883.

Grant, Surgeon-Captain A. E. The Indian Manual of Hygiene, being King's Madras Manual of Hygiene revised, re-arranged, and in great part re-written. Vol. I. Madras.

***Gruber, F.** Anleitungen für die Anlage von Kasernen und Militär-Spitälern in Osterreich—Ungarn, 1879. 152 pp., 4to. Wien, 1879.

*——— Beispiele für die Anlagen Kasernen und Truppen-Spitälern in Osterreich—Ungarn, 1880. Large fol., plates only. Wien, 1880.

*——— Die Versorgung der Gebäude mit Sonnenwärme und Sonnenlicht, 1888. 41 pp., 8vo. Wien, 1888.

***Gruber, Dr. Max.** Die neue bauordnung der aussenstadt Frankfurt, a.m. 21 pp., 4to. Wien, 1892.

*——— Anhaltspunkte für die verfassung neur Bauordnungen in allen die gesundheitspflege betreffenden beziehungen. 148 pp. (plates), 4to. Wien, 1893.

Guy, Prof. W. A., *M.B., F.R.S.* Public Health. 8vo. London, 1874.

***Haden, F. S.** Cremation an Incentive to Crime. 24 pp., 8vo. London, 1892.

***Hall, E. T.** Some Chief Causes of the Unhealthiness of Cities, with Suggestions for their Removal. 31 pp., 8vo. 1892.

***Hamilton, Robert.** Compulsory Notification of Infectious Diseases.

***Hartley, W. N.** Water, Air, and Disinfectants. 12mo. London, n.d.

Haviland, A. The Geographical Distribution of Disease in Great Britain. 2nd Ed. Large 8vo. London, 1892. (*See* Field, Rogers.)

Hayward, J. W., *M.D.* (*See* Drysdale.)

***Health** Exhibition Literature. 19 vols. 8vo. London.

***Hehir, Dr. Patrick.** Microscopical Observations on the Hœmotozöon of Malaria. 27 pp., 4to. Plates. Hyderabad, 1891.

*——— Microscopical Observations on the Hœmotozöon of Malaria, with an appendix containing a series of plates, illustrations, and descriptions. 27 pp., 4to. Hyderabad, 1892.

***Hellyer, S. S.** The Plumber and Sanitary Houses. 4th Edition. London [1887].

*——— Principles and Practice of Plumbing. 294 pp., 8vo. London, 1891.

Hilger. (*See* Pettenkofer.)

***Hime, T. W.** (*See* Stevenson.)

---

* In Library of Institute.

***Hirt, L.** System der Gesundheitspflege. 8vo. 4. Auflage, Breslau, 1889. 5/-

——— (*See* Pettenkofer.)

Hobrecht. Die Kanalisation von Berlin. Plates. Berlin, 1887.

Hodgetts, E. A. Brayley. The Death-trap in the House: 1. Is Sanitation a Failure. 2. "Reasonably Perfect." 3. The Fierce Light of Public Opinion. Crown 8vo. 1889. 1/-

***Hodson, George.**, *C.E.* A consideration on some of the conditions requisite for obtaining underground Water Supplies. 36 pp., 8vo. London, 1893.

Hofmann, E. Lehrbuch der gerichtlicher Medicin. Wien, 1890. 1. Hälfte. 10/-

Hood, C., *F.R.S.*, **& Dye, F.** A Practical Treatise upon Warming Buildings by Hot Water, upon Heat and Heating Appliances in general; with an inquiry respecting Ventilation. 8vo. London, 1837—1891. 15/-

***Hope, E. W.** (*See* Stevenson.)

Hornemann, E. Hygienische Abhandlungen. Braunschweig, 1881. 8/-

***Howse, H. G.** (*See* Stevenson.)

Huebner, W. Uber Kanalwasserreinigung duch einfaches Sedimentiren ohne fallende Zusätze. 8vo. Engravings. Halle, 1893. 1/-

Hughes, S., *F.G.S.* Treatise on Water-works for the Supply of Cities. 12mo. London.

Humphreys, Noel H. (*See* Farr, W.)

***Ingram, M.** The Domestic Bath, Lavatory and Water-closet, their danger to the public health and how to prevent it. 10 pp., 8vo. 1891.

***Innes, Cosmo,** *M.Inst.C.E.*, and **Burton, W. K.** Sanitary Inspection of Dwelling Houses.

Janke, O. Grundriss der Schulhygiene. 8vo. 1890. 1/6

Jenner, Sir W., *M.D.* Lectures and Essays on Fevers and Diphtheria, 1849 to 1879. London, 1894. 25/-

Joltrain, A., *Sec. Soc. Fran. d'Hyg.* Les services Sanitaires de Paris. 12mo. Paris, 1893.

Kent, Walter G. The Water Meter, its difficulties, types, and applications; a Manual of reference and fact in connection with the supply of Water by Meter. Crown 8vo. With Illustratians. London, 1892. 3/6

***Kenwood, Dr. H. R.** Public Health Laboratory Work. 491 pp., 8vo. London, 1893. 10/6

Kittredge, A. O., *Editor.* The Metal Worker, Essays on House Heating by Steam, Hot Water, and Hot Air. Demy 8vo. With 82 full-page plates. 1892. 12/6

---

* **In Library of Institute.**

***Klein, E.** (*See* Stevenson.)

***Knight's** Annotated Model By-laws. 3rd Ed. 242 pp., 8vo. London, 1890.

Krahmer, L. Handbuch der Staatsarzneikunde. 3 Bde. Halle, 1874-79. 45/-

1. System d. Medizinalordnug. 7/-
2. Hygienie. 18/-
3. Gerichtliche Medizin. 20/-

***Kramer, Folkert N.** Die Radikalheilung der Diphtheritis ohne Nachkrankheiten im Kindesalter.

Kunkel. (*See* Pettenkofer.)

Latham, Baldwin, *C.E.* Sanitary Engineering. Sewerage. 2nd Edition. 8vo. London and New York, 1878. *Out of print.* ? £3.

***Law, H.,** *C.E.*, and **Clark, D. K.,** *C.E.* The Construction of Roads and Streets. 8vo. London, 1887. 4/6

***Laws, J. P.** (*See* London County Council.)

Leffman, Henry, *M.D.*, *Ph.D.*, *Professor of Chemistry, Pennsylvania*, and **Wm. Beam,** *M.A.* Examination of Water for Sanitary and Technical Purposes. Crown 8vo.

Lehmann, K. B. Die Methoden der prakt. Hygiene. 8vo. 1890. 16/-

——— (*See* Crookes.)

Liebermann, L. Die chemische Praxis auf die Gebiete der Gesundheitspflege und der gerichtliche Medizin. 1883. 6/-

***Lobley, J. L.** The Supply of Water to London in the near and distant future. 32 pp., 8vo. London, 1892.

***London County Council.** Report on Sewer Air Investigations by J. Parry Laws, F.I.C. 15 pp. London, 1893.

***Longstaff, Dr. G. B.** Studies in Statistics—Social, Political, and Medical. 455 pp., 8vo. London, 1891.

***Lowndes, F. W.** (*See* Stevenson.)

Lueger, O. Wasserversorgung der Städte. 3 Hefte. Darmstadt, 1890-92.

***Lunde, F. C.** The Latest Sanitary Improvements in Drainage Work. 7 pp., f. cap. Plates.

Macmorran, A. The Public Health (London) Act. 8vo. London.

***McVail, J.** (*See* Stevenson.)

Maguire, W. R. Domestic Sanitary Drainage and Plumbing. 437 pp., 8vo. London, 1890.

Manning, Robert, *M.I.C.E.* Sanitary Works Abroad; Report of the Commission appointed to propose Measures for Remedying the Pollution of the Seine, with a Description of the Works in course of execution for the Sewage of Berlin, and the application of Sewage to Irrigation at Marienfelder and Falkenburg. Translated from the French. 8vo. 1876. 2/-

---

*** In Library of Institute.**

***Mansergh, Jas.**, *M.Inst.C.E., F.G.S.* The Thirlmere Water Scheme of the Manchester Corporation, with a few Remarks on the Longdendale Works and Water Supply generally. 8vo., with Maps. London, 1878. 1/6

Marggraff, H. Wasserversorgung, Canalisation und abfuhr. Munchen, 1879.

***Martin, S. H. C.** (*See* Stevenson.)

Maxwell and **Tuke.** Borough of Rochdale: Suggestions for the Economical Collection and Disposal of the Sewage, and the Utilization of the Solid Refuse. 8vo. 1880. 1/-

***Meade, T. de Courcy**, *C.E.* Report to the Hornsey Local Board on Intercepting Traps and Water-tight Drains. 27 pp., 8vo. Plates. London, 1893.

Merkel. (*See* Pettenkofer.)

***Michael, W. H.**, *Q.C.* A Paper on Compulsory Notification of Infectious Diseases.

***Middleton, G. A. T.** House Drainage. 63 pp., 8vo. London, 1892.

***Middleton, R. E.**, *C.E.* House Drainage, Sewerage and Ventilation.

*——— Water Supply for small Towns and Villages.

***Miers, H A.** The Soil in Relation to Health. 135 pp., 8vo. London, 1893.

Mills, J. H. Heat: Science and Philosophy of its Production and Application to the Warming and Ventilation of Buildings. The arranging, and transmitting power of different Boiler and Radiator surfaces with Steam and Water Circulation. Ventilation by Fans and Water Motors with Hydrant pressure; also Plans and Diagrams of experimental work, and results of actual construction. 2 vols. Royal 8vo. 1890. 12/6

***Model By-Laws** under the Public Health Amendment Act, 1893. 8vo. London, 1893.

***Mullins, George Lane.** Registration of Still Births and the Protection of Infants. 8 pp., 8vo. Sydney, 1892.

Munck, J. (*See* Weyl, T.)

***Murphy, Shirley F.** Our Homes, and How to make them Healthy. 947 pp., 8vo. London, 1885.

——— (*See* Stevenson.)

Neuman (*See* Fleming.)

Newsholme. Dr. Arthur. School Hygiene: the Laws of Health in Relation to School Life. Crown 8vo. 1888. 1/6

*——— Vital Statistics. 8vo. London, 1889.

*——— Hygiene: a Manual of Personal and Public Health. 448 pp., 8vo. London, 1892.

*——— The Brighton Life Table (based on the mortality of the ten years 1881-90). 39 pp., 8vo. Brighton, 1893.

---

* In Library of Institute.

Newsholme, Dr. Arthur. Elementary Hygiene: Lessons on Health. New Edition. 1893. 2/6

***Nichols, Wm. Ripley,** *Professor at the Massachussetts Institute of Technology.* Water Supply, considered mainly from a Chemical and Sanitary standpoint. 4th Edition. Royal 8vo. New York, 1883. 12/6

***North, S. W.,** *M.D., M.O.H. York.* The Milk Trade as affecting the Public Health. 8 pp., 8vo. Leeds, 1889.

*——— Report on Diphtheria.

***Notter, J. Lane,** *M.D., Professor of Military Hygiene in the Army Medical School, Netley.* Editor. Parkes Manual of Practical Hygiene. 8th Edition, with 10 Plates and 103 Wood Engravings. 8vo.

*——— The Soldier's Food, with reference to Health and Efficiency for Service.

*——— (*See* Stevenson.)

Ochwadt, A. Die Gesundheitspflege der deutschen Soldaten. Berlin, 1882. 5/-

Oesterlen, E. Handbuch der Hygiene. 1876. 18/-

***Oliver, Dr. Thomas.** Lead Poisoning in its acute and chronic forms. 121 pp., demy 8vo. Edinburgh and London, 1891.

Onimus, Dr. E. L'Hiver dans les Alpes-Maritimes et dans la principauté de Monaco. Climatologie et Hygiène. 2^e édition, revue et modifiée, avec 62 fig. 16mo. Paris. 2/6

Osthoff, G. Anlagen für die Versorgung der Städte mit Lebensmitteln. Markthallen, Schlachthöfen und Viehmärkte. Jena, 1894. Mit 22 Abb. 2/-

***Paget, Charles E.** County and Borough of Salford. Special Report on the Recent Prevalence of Diphtheria. 33 pp., 8vo. Maps. Salford, 1891.

***Palmberg, Dr. A.** Traité de l'Hygiène Publique d'aprés ses applications dans différents pays d'Europe. Traduit du suédois sous le direction de M. A. Hamon. 618 pp., 8vo. Paris, 1891.

***Parent-Duchatelet, A. J. H.** Hygiène Publique, ou Mémoires sur les questions les plus importantes d'Hygiène. 2 Vols. 8vo. Paris, 1836.

***Parkes, E. A.,** *M.D., F.R.S.* (*See* Notter.)

***Parkes, Dr. Louis.** Hygiene and Public Health. 3rd Edition, 523 pp., 8vo. London. 1892. 10/6

*——— Infectious Diseases, Notification and Prevention. 185 pp., 8vo. London, 1894.

——— (*See* Stevenson.)

***Parodi, C.** L'Igiene nella Costruzione degli Ospitali.

***Parry, J.,** *C.E.* Water Supply. 184 pp., 8vo. London, 1890.

*——— Water: its Composition, Collection, and Distribution. A Handbook for general use. New Edition, with illustrations. Crown 8vo. 1892. 3/6.

---

* **In Library of Institute.**

Paterson, M. McC., *Mem.Inst.C.E.* The Pollution of the Aire and Calder, and how to deal with it. 32 pp., 8vo. London, 1893. 1/-

Peggs, J. W., *Assoc.M.Inst.C.E.* Water Supply for Domestic Use. 8vo. London, 1894. 1/- (*Excerpt Trans. San. Inst.)*

Pettenkofer, Prof. M. Von und **Ziemssen.** Handbuch d. Hygiene und Gewerbekrankheiten. 3 Thle. Leipzig, 1882-83.
I. Theil. Specieller Theil. A. Individuelle Hygiene.—
1. Abth. Einleitg. *v.* Pettenkofer. Ernährg. u. Nahrgsmittel v. Forster. Verfälschg. d. Nahrgs, u. Genussmittel v. Hilger. 1882. 6/-
2. Abth. 1. Fermente Mikroparasiten v. Flügge. 1883. 6/-
II. Theil. Sociale Hygiene.—
1. Abth. 1. Grössere Gemeinwesen. 1. Hälfte: Anlage v. Ortschaften v. Flügge. Abfuhr v. Erismann. Beerdiggswesen. v. Schuster. Massenernährg. v. Forster. 1882. 8/- *2. Hälfte: Wasserversorgg. v. Wolffhügel. 1882. 5/-
2. Abth. 2. Specielle sociale Einrichtgn: Schulhygiene v. Erismann. Gefängnisse v. Baer. Fabriken v. Hirt. Krankenanstalten v. Degen. Kasernen v. Schuster. Bäder v. Renk. Verkehrsmittel v. Kunkel. 1882. 9/-
4. Abth. Gewerbekrankheiten v. Merkel u. Hirt. 1882.
III. (Allgem.) Theil. Oeffentliche Gesundheitspflege v. Geigel. 1882.

Pettenkofer, Prof. M. von. Untersuchgn. und Beobachtgn. über die Verbreitungsart der Cholera. München, 1855. 7/-

Pettenkofer, M. Boden und Grundwasser in ihren Beziehgn. zu Cholera und Typhus. München, 1869. 3/-

——— Ueber die gegenwärtigen Stand der Cholerafrage. München, 1873. 1/6

——— Künftige Prophylaxis gegen Cholera. München, 1875. 2/6

——— Beziehungen der Luft zu Kleidung, Wohnung, und Boden. Braunschweig, 1877. 3/-

——— Ueber die Werth die Gesundheit. Braunschweig, 1877. 1/6

——— Vorträge über Canalisation u. Abfuhr. München., 1880.

——— Das hygienische Institut d. Universität München. Braunschweig, 1882. 3/-

——— Hygienische Untersuchungen. Zum 50. Doctorjubiläum gewidmet vom niederrhein. Verein für öffentliche Gesundheitspflege. Bonn, 1893. Mit Portr., Abb. u. 1 Karte. 5/-

——— Über die Cholera von 1892 in Hamburg und über Schutzmassregeln. München, 1893. 1/-

Phillips, John, *C.E.* The Drainage and Sewerage of Towns. 8vo. London. 1872. 1/6

***Pilley, J. J.** Hygiene, the Principles of Health. 190 pp., 8vo. London, 1888.

---

* In Library of Institute.

***Pilley, J. J.** South Kensington Hygiene. 190 pp., 8vo. London, 1889.

Plange, W. Die Infections-Krankheiten, ihre Entstehg., ihr Wesen, und ihre Bekämpfg. Berlin. 2/6

Plunkett, Mrs. H. M. Women, Plumbers, and Doctors; or Household Sanitation. Illustrated. Crown 8vo. 1893. 6/-

Pollard, J. A study in Municipal Government. The Corporation of Berlin. Small 8vo. Edinburgh, 1893.

***Poore, Dr. G. V.** Rural Hygiene. 318 pp., 8vo. London, 1893.

*——— London, Ancient and Modern, from a Sanitary and Medical point of view. 8vo. London, 1889.

*——— (*See* Stevenson and also Worthington.)

***Power, Dr. J. B.** The Powers and Duties of Sanitary Inspectors. 16 pp., 8vo. *Reprinted from Dublin "Journal of Medical Science."* July, 1893.

Price, John, *Assoc.M.Inst.C.E.* Lecture on Scavenging and Disposal of Refuse. With 8 plates. 27pp., 8vo. Liverpool, 1892. 1/6

***Putzeys, Felix.** L'Epidémie de Trichinose de la prealle-herstal. 16 pp., 8vo. *Extrait du Bulletin de l'Academie Royale de médecine de Belgique, année,* 1893.

Rafter, George W., and **Baker, M. N.** Sewage Disposal in the United States. Part I. Discussion of Principles; Part II. Description of Works. 600 pp. 1 vol., royal 8vo. 1894. 24/-

***Ransome, A.** (*See* Stevenson.)

Rawlinson, Sir Robert, *K.C.B., M.Inst.C.E.* Suggestions as to Drainage, Sewerage, and Water Supply.

***Redgrave, A.** The Factory and Workshop Acts, 1878—91. 298 pp., 8vo. London, 1893.

Reeves. R. Harris. Bad Drains and how to test them, with Notes on the Ventilation of Sewers, Drains and Sanitary Fittings, and the Origin and Transmission of Zymotic Disease. Crown 8vo. London, 1885. 3/6

*——— Sewer Ventilation and Sewage Treatment. 57 pp., 8vo. London, 1889.

Reichhardt, E. Desinfektion. Stuttgart, 1881. 3/-

***Reid, Dr. G.** Practical Sanitation. 300 pp., 8vo. London, 1892.

Reincke, J. Gesundheitspflege auf Seeschiffen. Hamburg, 1882. 3/-

Rembold, S. Schulgesundheitspflege. 8vo. 1889. 3/-

Renk. (*See* Pettenkofer.)

***Richardson, Dr. B. W.** Health of Nations. A Review of the Works of Edwin Chadwick. 377 pp. and 440 pp., 2 vols., 8vo. 1887.

***Richmond** Main Sewerage and Drainage. An account of the works carried out by the Richmond Main Sewerage Board for the collection and disposal of the sewage of the parishes of Richmond, Barnes, Mortlake, Kew, and Petersham. 16 pp., maps. London, 1891.

---

* **In Library of Institute.**

***Robinson, H.**, *M.Inst.C.E.* Vestry Neglect in Sanitary Matters.

*——— Paper on Sewage Disposal with reference to River Pollution and Water Supply. 11 pp., 8vo. *Excerpt from Trans. International Congress of Hygiene and Demography*, 1891.

*——— Sewage Disposal, containing Information for Sanitary Authorities and Sanitary Engineers. 2nd Edition. Crown, 8vo. London and New York, 1882. 5/-

Roechling, H. Alfred, *Assoc.Mem.Inst.C.E.* Sewerage and Sewage Disposal Works at Leicester. 8vo. 1890. 1s.

Rosenthal, J. Vorlesungen über die offentlich und privaten Gesundheitspflege. 8vo. 2. Auflage, 1890. 12/-

Rossignol, H. et Dechambre. Eléments d'hygiène et de zootechnie. Paris, 1894. Avec fig. 5/-

***Roster, Prof. Dr. G.** Sul Novo tipo brevettato di Latrina Igea. 11 pp., 8vo. Torino, 1893.

*——— La acque di condotto di firenze. 23 pp., 8vo. Milan, 1893.

*——— Le acque freatiche della pianura di firenze. 21 pp., 8vo.

*——— L'acide carbonico die suolo. 18 pp., 8vo.

Rowan, T., *C. E.* Disease and Putrescent Air; Ventilation of Sewers; House Drains and Connections. 8vo. London, 1883. 2/-

***Ruata, Dottor Carlo.** Trattato d'Igiene pubblica. 270 pp., 8vo. 1892.

Rubner, M. Lehrbuch der Hygiene. 8vo. 1890. 20/-

***Russell, Dr. J. B.** On some of the Relations of the Business of the Dairy Farmer to Public Health. 20 pp., 8vo. Glasgow, 1890.

***Russell, Hon. Rollo.** The Spread of Influenza, its supposed relations to Atmospheric Conditions. 59 pp., 8vo. London, 1891.

*——— Epidemics, Plagues and Fevers, their Causes and Prevention. 508 pp., 8vo. London, 1892.

Rziha, F. Ritter v., d. Problem d. Wiener Wasserversorgg.

Salis, Rodolph De, *B.A.*, *Assoc.M.Inst.C.E.* Tables giving Hydraulic mean depth and area of Circular Sewers, from 3 inches to 30 inches in diameter, when flowing one-quarter, one-third, two-thirds, three-quarters full, and full; also their discharge and velocity at various gradients. 8vo. 1884. 1/-

Schauenburg, C. Handbuch der öffentlich und privaten Gesundheitspflege. Berlin, 1879.

Schicker, V., d. Krankenversicherungsgesetz u. d. Hülfskassengesetz mit Erläutergn. u. Musterstatuten. 2. Aufl. 9/-

***Schofield, Dr. A. T.** Health at Home Tracts. 190 pp., 8vo. London.

*——— Manual of Personal and Domestic Hygiene. 163 pp., 8vo. London.

---

* In Library of Institute.

***School Ventilation.** The problem of, with special reference to Ventilation by mechanical means. A Paper read before a Conference of School Board Clerks, Brighton, 1886. 20 pp., 8vo.

Schumann, F., *C.E.* Manual of Heating and Ventilation, for the use of Engineers and Architects. 18mo. New York, 1877. 7/6

***Scalvo, Dott. Achille.** Di alcune nuove proprietà dello spirillo colerigeno di Koch e degli spirilli affini di Metschnikoff. 15 pp., 4to. 1892.

***Shone, Isaac,** *C.E., F.G.S.* The Main Drainage of the Houses of Parliament, Westminster, on the Shone Hydro-Pneumatic System. Enlarged Edition. Royal 8vo. London, 1887. 5/-

*——— The "Shone" System of Town Drainage. A Paper read before the Incorporated Association of Municipal and County Engineers. Peterborough, June, 1892. 24 pp., 16mo.

***Simon, Sir John.** Public Health Reports. 1172 pp., 8vo. London, 1887.

***Slagg, Charles.** Sanitary Work in the Smaller Towns and Villages. 2nd Ed. 8vo. London, 1884. 3/-

*——— Water Engineering; a practical treatise on the measurement, storage, conveyance, and utilization of water. 8vo. London, 1888.

Smeaton, John, *R.P.* Plumbing, Drainage, Water Supply, and Hot Water Fittings. Numerous Engravings. 8vo, cloth. 7/6

Spinks, William, *Assoc. Mem. Inst. C.E.* The Law and Practice as to Paving and making good Private Streets, with Digest of Cases decided under the Public Health and Metropolis Management Acts. 3rd Edition, 8vo. London, 1892. 8/6

***Shaw, W. N.** (*See* Stevenson.)

***Smith, J. Barker.** Milk, a new system of rapid analysis. 24 pp., 8vo. London, 1892.

***Smith, P. G.** (*See* Stevenson.)

Stackpole, Capt. J. A guide to Meat Inspection. 8vo. London, 1891. 1/6

***Stevenson, Dr. T.,** and **Murphy, Shirley F.** A Treatise on Hygiene and Public Health. In 3 vols., royal 8vo., illustrated. London, 1892-3-4. 28/-, 32/- —

VOL. I. Notter, J. L.—Air.
Shaw, W. N.—Warming and Ventilation.
Symons, G. J.—Meteorology.
Williams, C. T.—Influence of Climate on Health.
Stevenson, T.—Water.
Copeman, S. M.—The Influence of Soil on Health.
Martin, S. H. C.—Food.
Hope, E. W.—The Inspection of Meat.
Poore, G. V.—Clothing.
Treves, F.—Physical Education.
White, W. H.—Baths.

---

* In Library of Institute.

Vol. I. (*continued*)—
Smith, P. G. }
Young, K. D. } The Dwelling.
Howse, H. G.—Hospital Hygiene.
Corfield, W. H. }
Parkes, L. C. } The Disposal of Refuge.
Hime, T. W.—Offensive and Noxious Trades.
Hope, E. W.—Slaughter Houses.

Vol. II. Armstrong, H. E.—Marine Hygiene.
Ashby, A.—The Medical Officer of Health.
Klein, E.—The Pathology and Etiology of Infectious Diseases.
Lowndes, F. W.—Disposal of the Dead.
McVail, J.—Small-pox and Vaccination.
Notter, J. L.—Military Hygiene.
Ransome, A.—Vital Statistics.
Thompson, T. W.—The Natural History of Infectious Diseases.
Wells, Sir T. Spencer—Disposal of the Dead.

Vol. III. In preparation.

Stone, T. W., *C.E., District Surveyor for Water Supply, Victoria, Australia.* Notes on Water Supply. Crown 8vo. 18 Plates. London, 1888. 5/-

***Stratton's** Public Health Acts. 270 pp., 8vo. London, 1890.

***Street, W. C.** Some Problems of Town Development. 12 pp., 4to. *Excerpt "Journal Royal Institute of British Architects," Vol. IX., New series.*

***Sutcliffe, J. D.** Warming and Ventilation of Public Buildings with or without Motive Power. A Paper read before the Philosophical Society of Glasgow, 18th January, 1892. 16 pp., 8vo.

***Sworder, H.** Popular Information concerning Infectious Diseases. 82 pp., 8vo. London, 1893.

***Sykes, Dr. J. F. J.** Public Health Problems. 370 pp., 8vo. London, 1892. (*Contemporary Science Series.*)

*—— Objects and Methods of Inspection.

***Symons, G. J.**, *F.R.S.* (*See* Stevenson.)

***Tarn, E. Wyndham.** The Science of Building. 216 pp., 16mo. London, 1890.

***Taylor, A.** The Sanitary Inspector's Handbook. 243 pp., 8vo. London, 1893.

***Terry, Stephen Harding,** *Assoc.M.Inst.C.E.* Street Watering with Sea Water.

***Thomas, E. Lewis.** The Public Health (London) Act, 1891, with full explanatory notes. 393 pp., 8vo. London, 1891.

***Thompson, Sir Henry.** Food and Feeding. 222 pp., 8vo. London, 1891.

*—— Modern Cremation: Its history and Practice. 163 pp., 8vo. London, 1891.

***Thompson, T. W.** (*See* Stevenson.)

***Thorne, Dr. Thorne.** On the Progress of Preventive Medicine during the Victorian Era. 8vo. London, 1888.

---

* In Library of Institute.

***Thorne, Dr. Thorne.** Diphtheria, its Natural History and Prevention. 266 pp., 8vo. London, 1891.

*——— Cholera Prospects and Prevention. 31 pp., 16mo. London. 1893.

***Thresh, Dr. John C.** The Housing of the Working Classes in the Chelmsford and Maldon Rural Sanitary Districts. 24 pp, 8vo. Chelmsford, 1891.

Thwaites, B. H., *C.E.* Our Factories, Workshops, and Warehouses: their Sanitary and Fire-Resisting Arrangements. 1893. 9/-

***Trelat, Emile.** Régime de la Température de l'air dans la Maison.

*——— Théorie du Chauffage des Habitations. 11 pp., 8vo. Paris, 1892.

***Tracy, Roger S.**, *M.D., Sanitary Inspector, New York City.* Handbook of Sanitary Information for Householders, containing facts and suggestions about Ventilation, Drainage, Care of Contagious Diseases, Disinfection, Food and Water, with Appendices on Disinfectants and Plumbers. 8vo. New York, 1884. 2/6

***Treves, F.** (*See* Stevenson.)

Trillich, H. (*See* Emmerich.)

Tuke. (*See* Maxwell and Tuke.)

Turner, J. H. T., *B.Sc., M.Inst C.E.*, and **Brightmore, A. W**, *M.Sc., Assoc.M.Inst.C.E.* The Principles of Waterworks Engineering. Cuts. Medium 8vo. 1893. 25/-

***Turner, T. J.**, *M.A., M.D.* The Hygiene of Emigrant Ships.

***Tylor, W. A.** House Drainage.

***Uffelmann, J.** Handbuch der Hygiene. 1. Hälfte. Wien, 1889. 10/-

——— Darstellg. d. auf d. Gebiete d. öffentl. Gesundheitspflege in ausserdeutschen Ländern bis jetzt Geleisteten. Berlin, 1878. 10/-

———Handbuch der öffentl. Hygiene d. Kindes. Leipzig, 1881. 11/-

***Vacher, Francis.** The Food Inspector's Handbook. 140 pp., 8vo. London, 1893. 2/-

*——— Defects in Plumbing and Drainage Work. 83 pp., 8vo. London, 1889.

Varona, A. D., *A.M., M.D.* Sewer Gases: Their Nature and Origin, and how to Protect our Dwellings. 18mo. 2/-

***Wallace, J.** Sanitary Engineering in India. 238 pp., 8vo. Bombay. 1893.

***Walley, Thomas.** A Practical Guide to Meat Inspection. 188 pp., 8vo. Edinburgh, 1890.

***Wardle, T.** Sewage Treatment and Disposal. 426 pp., 8vo. Manchester and London, 1893.

---

* In Library of Institute.

Wanklyn, J. A., and **Chapman, E. T.** Water Analysis, a Practical Treatise on the Examination of Potable Water. Crown 8vo. 1876. 1/6

*__Waring, Col. G. E.__ The Sanitary Drainage of Houses and Towns. Crown 8vo. Numerous Engravings. New York, 1878. 10/6

*——— Sewerage and Land Drainage. 406 pp., 4to. Illustrations. London and New York. 1889. 30/-

——— The Sewerage of Colombus, Ohio. 24 pp., 8vo. Columbus, 1890.

*——— The Sewerage of two New Hampshire Towns—Keene and Laconia. 14 pp., 8vo. Concord, 1892.

*——— Sewage Disposal of Wayne, Pa. 4 pp., f.cap. *Reprint from the American Architect*, 2nd July, 1892.

*——— Sewage Disposal for Isolated Houses and large Institutions. 7 pp., f.cap. *Reprint from the American Architect*, April, 1892.

*——— The Memphis System of Sewage at Memphis and elsewhere. 18 pp., 8vo. "Concord" Public Health, 1893. *Reprint from Transactions of the American Public Health Association. Vol. XVIII.*

*——— Report on the Condition of the Sewers of Memphis, March 4th, 1893. 10 pp., 8vo. Memphis, 1893.

*__Wells, Sir T. Spencer.__ (*See* Stevenson.)

Wernich, A. (*See* Weyl, T.)

Weyl, Th. Die Einwirkung hygienischer Werke auf die Gesundheit der Städte, mit besond. Rücksicht auf Berlin. Jena, 1894. 2/-

——— Handbuch d. Hygiene.

1. Geschichtliche Entwickelung und Organization der öffentliche Gesundheitspflege in die Kulturstaaten von C. Finkelnbur.
2. Einzelernährung und Massenernährung von J. Munck.
3. Leichenwesen, einschliesslich die Feuer bestattigung von A. Wernich.
4. Hygiene d. Bodens mit besondere Rückseit auf Epidemiologie und Bauwesen von J. von Fodor. 4/6

*__White. W. H.__ (*See* Stevenson.)

*__Whitelegge, Dr. B A.__ Hygiene and Public Health. 531 pp., 8vo. London, 1890.

Wiel und **Gnehm.** Handbuch der Hygiene. Karlsbad, 1880. 20/-

*__Williams, C. R.__, *Assoc.M.Inst.C.E.* Carriage-way Pavements practically considered.

Williams, Dr. C. Theodore. Aero-Therapeutics; or, the Treatment of Lung Diseases by Climate. With an Address on the High Altitudes of Colorado. 8vo. London, 1894. 6/-

*——— (*See* Stevenson.)

*__Williams, R.__, *A.R.I.B.A.* London Rookeries and Colliers' Slums; a Plea for more Breathing Room. Diagrams, &c. 1893.

*__Willoughby, Dr. E. T.__ The Health Officer's Pocket Book. 376 pp., 16mo. London, 1893.

---

* In Library of Institute.

*__Wilson, Andrew.__ A Manual of Health Science. 8vo. London, 1885.

Wilson, E. H. Metropolis Local Management Acts.

***Wilson, Dr. G.**, *F.R.S.E.* Sanitary Defects in Villages and Country Districts. 8vo. London, 1876.

——— Handbuch der öffentlich und privat. Gesundheitspflege. Berlin, 1877.

*——— Healthy Life and Healthy Dwellings. 8vo. London, 1888.

*——— Handbook of Hygiene and Sanitary Science. 7th Edition, 751 pp., Crown 8vo. London, 1892. 12/6

Winter, E., und Brix, J. die Wasserversorgung und Canalisation d. Stadt Wiesbaden. (Festschrift d. Stadt f. d. 60. Naturf.-Vers.) Mit Tafeln. 8vo. Wiesbaden, 1887. 3/-

Wolff, E. Bericht über die öffentlich Gesundheitswesen der Reg.-Bez. Merseburg für 1889, 1890 u. 1891. 4/-

Wolffhusel, Prof. Dr. G. Zur Lehre vom Luftwechsel. 75 pp., 8vo. München, 1893.

——— (*See* Pettenkofer.)

Wolpert. Theorie und Praxis der Ventilation und Heizung.

***Woolrych's** Metropolis Local Management Act. 8vo. London, 1880.

***Worthington, T. Locke,** *A.R.I.B.A.* (with an Introduction by G. V. Poore, M.D.) The Dwellings of the Poor and Weekly Wage earners in and around Towns. Plans, &c. 1893. 2/6.

Wylde, W. The inspector of Meat, 8vo. 32 coloured plates. London, 1890.

***Young, R. D.** (*See* Stevenson.)

Ziemssen. (*See* Pettenkofer.)

Zimmermann, O. E. R. Die Bakterien unsere Trink. u. Nutzwässer insbesondere der Wassers der Chemnitzer Wasserleitg. 2. Reihe. 4/-

*** In Library of Institute.**

REVIEWS OF BOOKS.

STEVENSON AND MURPHY'S HYGIENE.*

Article on Vital Statistics by ARTHUR RANSOME, M.D., M.A., F.R.S.

In some forty pages Dr. Ransome has brought together a large mass of interesting and suggestive matter. One cannot rise from the perusal of his article without a clearer realisation of the fact

---

*** A Treatise on Hygiene and Public Health. Edited by Stevenson and Murphy, 3 vols. J. & A. Churchill. 1892-93-94.**

that vital statistics are "the foundation of sanitary effort, and the basis of the work of medical officers of health." We have noticed one minor inaccuracy, which may be rather a lax statement than an actual error. This is, however, of small importance, and does not detract from the excellence of the article.

In stating the methods of calculating populations in inter-censal years, it appears to be assumed that the only difference between the method which assumes that the increase each year is one-tenth of that for the total decennium, and the method used by the Registrar-General is that in the latter the use of logarithms facilitates the calculation, whereas there is the fundamental difference which holds between arithmetical and geometrical progression. Although an instance of the correct method is given in a footnote on p. 469, it appears to be assumed, in the statement on p. 471 (as in arithmetical progression), that the increase *does not go on increasing* with the progress of the decade.

The remarks on statistics of sickness are very judicious, as might be expected from one who was a pioneer in this special work. The statement (which was probably written some three years ago) that some fifty towns have adopted the compulsory notification of certain infectious diseases hardly covers the present facts; for at least three-fourths of the population of England has adopted the Act in question. It is well to be reminded that isolation and disinfection are not the only means by which these diseases are to be met. We ought to try and prevent their origin; and for this purpose a more accurate knowledge of their natural history is necessary. It should also "be possible to predict the coming of an epidemic with at least as much certainty as we now receive the tidings of a coming cyclonic storm, and its probable track should be marked out before its arrival."

In dealing with sources of fallacy in death-rates, Dr. Ransome emphasises the well-known fact that domestic servants very commonly do not die in the district in which they have worked. This fact "is the chief cause of the abnormally low death-rates of the suburbs of towns," not the superior sanitation on which they may pride themselves. A death-rate of 10 per 1000, may not unreasonably be described as "an impossible death-rate", one which could not possibly occur in a population normally constituted, and the statistics of which are not vitiated by the disturbing influence of migration.

We are glad to see that the charts of deaths from various infectious diseases in Sweden over a long series of years are embodied in Dr. Ransome's article. For the epidemiologist they are of permanent interest, and they will now in their new home have a fit housing and be easily consulted.

On certain points we confess we should have liked fuller details; for Dr. Ransome is a sound authority, and it is desirable that the results of his statistical experience and research should be set forth *in extenso*. But in a composite work like the present, in which each writer is probably limited to a certain number of pages, this has been unattainable.

ARTHUR NEWSHOLME.

Article on Warming and Ventilation by Professor W. M. SHAW.*

In the introduction the author, after pointing out that the subjects of warming and ventilation may be regarded mainly as special technical departments of the sciences of *heat, hydraulics*, and *pneumatics*, proceeds to give a short summary of those properties of heat and of air which are specially involved; namely, the production and measurement of heat, latent and specific heat, and the distribution of heat by conduction, by radiation, and by convection; the composition, weight, density, and pressure of the air, the dynamical cooling of the air, the impurities in the air, and the general movement of the air. He then proceeds to formulate a general theory of ventilation based upon the following four laws, namely:—1st. The law of continuity, *i.e.*, that the quantity of air in the space which is contained between any two parallel sections of the system is invariable; in other words, that the amount which crosses one section to enter the space is the same as the amount which crosses the other section leaving the space. 2nd. That the ratio of the head producing the movement of the air to the square of the flow is a constant which is inversely proportional to the square of the area of the orifice. 3rd. That when two or more ducts are parallel and themselves produce no head, their effect is the same as that of a single duct whose equivalent orifice is equal to the sum of the equivalent orifices of the separate ducts. 4th. That the resistance of any number of ducts in series is the sum of the resistances of the separate ducts.

In order to fully determine the resistance of a duct and the head necessary to produce a given flow of air through the same, the author adopts the method employed by M. Murgue in his work on "*The Theories and Practice of Centrifugal Ventilating Machines.*" Starting from the simple case of the head required to propel a given volume of air through an orifice in a thin plate, the author obtains formulæ in the same terms for the more complicated cases of the resistances offered by the passage of a given volume of air through ducts of various forms and dimensions, and the corresponding heads required to overcome such resistances. He illustrates the method by its application to determine the resistances arising from

a. Work spent in friction of eddies at orifices of entry.
b. „ „ „ a rectangular bend.
c. „ „ „ a curved bend.
d. „ „ „ a sudden enlargement.
e. „ „ „ a sudden contraction.
f. „ „ „ at orifice of exit.
g. „ „ against the sides of the duct when the section is uniform.
h. „ in generation of the velocity of the air at the orifice of exit.

And having deduced separately formulæ for determining the heads required to overcome the resistances under these several items all expressed in the same terms, the total head is obtained by the summation of the several equations.

---

* See foot note, page 108.

The author then gives a summary of the causes available to produce motion of air for the purposes of ventilation, which he groups under the following headings:—

- (*a*.) Variation of barometric pressure and of temperature. Intermittent ventilation of enclosures.
- (*b*.) Direct impact of wind upon an opening.
- (*c*.) Wind blowing across the orifice of a duct. Ventilation by steam-jets.
- (*d*.) Head produced by ventilating-fans.
- (*e*.) Head produced by blowing engines.
- (*f*.) Head produced by hot air or smoke in flues.

In considering the first of these causes he points out a fact of considerable hygienic importance, namely:—"A fall of pressure of 1 inch causes the abstraction of 57 cubic inches of air from every cubic foot of the nearly closed space, and a rise of internal temperature of 1° F. causes the expulsion of 3½ cubic inches. Changes of air are thus effected in wells, cupboards, cases, cellars, cesspools, and other places, even when they have no apparent openings. And similar causes produce an expulsion of air from all soils which are porous and contain a quantity of air dependent on the barometric pressure."

Having elucidated each of the above-mentioned methods of producing a movement in the air, the author proceeds to apply the principles which he has formulated to special cases of rooms with various inlets and outlets. And he afterwards gives the results of experimental investigations of the action of certain ventilating systems. He then gives the following summary of the conditions to be satisfied to secure efficient ventilation:—

1. Quantity of air required.
2. The quality of the air required.
3. The positions of the inlet and extract flues.
4. Provision of a suitable head for extracts and inlets. Correct numerical proportion between areas of respective inlets or outlets.
5. Completeness of circulation.

And he concludes by describing the means of warming and cooling the air in houses and large buildings.

We can recommend the article to the notice of those who are engaged in the ventilation of buildings as being an excellent exposition of the theory of the subject, and of the physical laws upon which ventilation and the distribution of heat depend. It might, however, with advantage be supplemented by a chapter of a more practical character describing the construction of apparatus and arrangements of buildings to carry into effect the principles theoretically expounded in Professor Shaw's article.

HENRY LAW.

NOTES ON SANITATION ABROAD.

THE PROGRESS OF PUBLIC HEALTH WORK AT BUDAPEST.

By Dr. Fodor, *Professor of Hygiene, Budapest.*

Hungary and specially her capital, like the whole European Continent, have learnt much from England and have followed her example in the development in matters of public health and sanitation. Budapest may now well be proud of having been a worthy disciple of her noble teacher.

At Budapest public health affairs have chiefly to contend with the unusually rapid development and expansion of the town. Nature has blessed this place with a remarkably healthy and beautiful location. On one side of the mighty river Danube most picturesque hills and mountains look down, some of which are crowned by ancient historical edifices, Roman monuments, arenas and aqueducts. On the other bank the endless plain stretches far away, on which stands the modern part of the town, with its lines of palaces and with its seething motion and turmoil of labour, industry, and commerce. But this industry and commerce bring to this town large numbers of persons from the country and even from foreign parts. The consequence of this is that, in spite of the extraordinary activity in the building trade and the rapid increase in the number of houses, many houses are overcrowded and many parts of the town are congested. It is also noticeable that the lowest class of labourer with his usually numerous family forms an exceptionally large part of the general population.

The population of Budapest was at the beginning of the present century 50,000; in 1840 it rose to 100,000; in 1880 it was already 370,000; in 1890 it reached 500,000, and at present is scarcely less than 600,000 souls.

The town authorities are trying different methods to solve the question of locating the population, specially to improve the housing of the poorer classes. They have built emergency houses of a lighter construction, where the poorer people can obtain lodgings at moderate rents. Besides this they are setting apart large tracts of corporation land, and selling it at low prices to workmen's, public employé's, and such like building associations, to build cheap family houses thereon. The promotion of cheap family house building is notably with us a very important question, because here, as in Vienna and Berlin, dwelling houses are generally built in such splendid and costly style that the poorer people cannot afford to rent lodgings in them.

The hygienic conditions and the movement of the traffic in the streets was considerably improved by the opening of boulevards. It is not so very long ago that the splendid and spacious "Andrássy" Road, of nearly three kilometres in length, was opened, and soon after this the "Ring," of still greater length, was dedicated to the public use. Both roads lined with palatial buildings were constructed in less than ten years. These spacious and convenient thoroughfares were cut out of some of the densest and most congested parts of the town, where formerly only miserable houses stood in narrow lanes. By this operation light, air, and cleanliness was given to the whole neighbourhood.

At present the authorities are commencing operations for the opening and construction of a new and large thoroughfare through the oldest part of the town, which will give new life to many parts, and in conjunction with the contemplated fourth bridge over the Danube in the very centre of the town, will bring nearer and make more habitable the hilly parts on the right bank of the river.

There is another very important work under execution and steadily progressing, this is the *main drainage*.

The town has long possessed a network of sewers, but the main branches of this system open directly into the river at many points within the inhabited part of the town. The whole system of sewers will now be provided with three main collectors, which will carry the sewage into the river at a point far below the town. The contents of these collecting sewers, which are placed under the level of the other sewers, will, during the time of floods in the river, be raised up, and discharged by steam or by hydraulic power. At all other times, the sewage will flow out freely by gravitation. To protect the town against sudden flooding by exceptionally heavy rains and storms, there will be several storm-overflows along the banks of the river, which will permit the flood-water of the sewers to discharge itself directly into the river.

It is in contemplation, at a future time, to free this royal river from all pollution, at least as far as the capital is concerned, and to apply the sewage to agricultural purposes.

The Corporation of Budapest have devoted five and a half million florins—about £1,500,000—to the completion of the main drainage works.

As in all great towns, the *water supply* causes great difficulties here at Budapest. Leaving out of consideration the Roman aqueduct and some smaller works constructed during the Middle Ages, we may say that the first waterworks were constructed by W. Lindley Senior, an English engineer. This work consisted of large wells sunk on the banks of the river, into which the water from the river, and from the surrounding underground filtered. These waterworks have since then constantly been enlarged, chiefly by a collecting drain of perforated iron tubes laid parallel to the river, into the gravel-bed under the banks of the river. But the further extension of these waterworks was arrested by the expansion of the town. Five years ago, sandbeds were constructed by which the water of the Danube is artificially filtered.

But all these works were insufficient to satisfy the exigencies of the growing population. In recent times, wells have been sunk on the left bank of the river at a point some 10 kilometres above the town. These wells receive their water in the same manner as in the former works, that is, partly from the river, and partly from the surrounding subsoil. The water is sent into town by mains of 1·20 metres—equal to 4 feet English—in diameter.

The water derived from these wells is tolerably good in quality and plentiful in quantity. But all this will scarcely satisfy the requirements of the town. The population is already clamouring for spring water. There is excellent and plentiful water to be had from springs existing about 80 kilometres—about 50 English miles—to the westward of the metropolis. It is desired to utilise these waters for the supply of our capital, the only drawback to it is its temperature, which is constantly at 20°·4 centigrades (68° Fahr.).

The present waterworks are capable of supplying about 200 litres—44 gallons—of water per head per diem; still this seems to be insufficient, it is believed, because the water is served out freely on the constant supply system—except in the case of factories and mills, where it is supplied by meters—and it is, therefore, supposed that great waste of water takes place.

For the waterworks now under construction, which, like all the public waterworks here, belong to the Corporation, six millions of florins—about £550,000—have been voted. These works when completed will be capable of supplying daily 120,000 cubic metres of water—about 26,700,000 gallons.

Budapest being situated in the centre of a very fertile country, is easily and well supplied with food, nevertheless there exist some great defects in the provisioning of the town. There are no well located *Market halls* where the whole process of provisioning might be centralised. To remedy this defect the corporation is going to build a large central Market hall and eight smaller ones for retail in the various districts of the town.

The central Market hall will later on, also be used for export business. This Central hall as designed by Professor Petz, will cover 11,000 square meters, or 2¾ acres of space, it will be connected by rail with the main railway lines and by an underground gallery with the quays of the river. The vaults under the hall will contain refrigerating chambers, store-rooms and spacious depôts. The cost of all the Market halls is estimated at 8·3 millions of florins—about £760,000.

Besides providing for the expenses of these large public works in contemplation, the corporation devote annually large sums to other public works, such as street cleaning, paving and road building (nearly two millions of florins), for schools (two millions) and for hospitals.

A few years ago a large *Communal Hospital* built on the pavilion system was opened for use, and a new hospital for infectious diseases will soon be completed; besides this there is in contemplation the erection of two new general hospitals for the outlying districts of the capital.

In the communal hospitals—not including the state, charity, and private hospitals—there is accommodation for 2,000 patients. The present temporary *station for disinfection* will soon be replaced by a permanent institution of the same kind.

The dust and refuse of the town is carried far away by special contractors, and is mostly used as fertilizer for agricultural land.

The Communal Administration of Public Health Affairs is now regulated by law. The service in the central office is carried on by a Chief Medical Officer of Health with his Staff, and in the various districts by District Medical Officers of Health, and by Physicians of the Poor (several to each district), and also by Certified Midwives, Veterinary Officers, and Inspectors of Nuisances.

This brief description will give some idea of the state of public health at Budapest, and of the great public works, which the different authorities have already executed, as well as those which are still under execution.

But we are quite justified in asserting that the great material sacrifices made, have already borne the desired fruits. The most palpable proof of this assertion, is the remarkable improvement in the death-rate. The mortality at Budapest has been gradually and steadily decreasing since 1874, from 44·9, 44·5 and 41·9 in 1874, 1875 and 1876 respectively, to 29·2, 27·9 and 28·0 in 1890, 1891 and 1892.

This rate of mortality during the latter three years, as compared with the former rate, signifies a yearly saving of 9,000 human lives.

It is due to this activity in sanitation that the cholera, which was repeatedly imported from abroad, caused during 1892 and 1893 only very insignificant epidemics as compared with those of former times.* Typhoid fever has also become much rarer.† But the most brilliant achievement, of which Budapest and the whole country can boast, is the successful combatment of small-pox. Vaccination has for a long time been in general practice in Hungary, but in 1887 *vaccination* and *re-vaccination* at the age of twelve years was made *compulsory* by Statute. The result of this enactment is best demonstrated by the following figures :—

Deaths from Small-pox.

	Before introduction of comp. vacc. and re-vacc.		After introduction of comp. vacc. and re-vacc.	
	1886.	1887.	1888.	1889.
In Hungary...	2477	1760	102	115
In Austria ...	1005	1022	1440	1180

Thus it is shown that in neighbouring Austria, where there is no compulsory re-vaccination law, the death-rate increased during the period of 1886—89, whilst in Hungary, after the introduction of compulsory vaccination and re-vaccination, it at once fell to nearly one-twentieth of its former height.§

These data are of interest to medical men and specially to hygienists. I am also of opinion that the important Sanitary works now under execution at Budapest are objects of great interest even to foreign hygienists, and are fit objects for practical study for the members of the International Congress of Hygiene, which is to be held in this city from the 1st to the 9th of September.

---

* It caused in 1892 525, and in 1893 105 deaths, whereas the epidemic of 1872—73 caused 2558 deaths.

† It caused 1864—68 annually 280 deaths per 100,000 of the population; in 1874—78 144; and in 1889—93 only 39. It is evidently steadily decreasing.

§ In Budapest the mortality by variola has been from 1887—93: 376, 14, 0, 0, 2, 4, 6.

NOTES ON LEGISLATION AND LAW CASES.

Prepared by Prof. A. Wynter Blyth.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Before Mr. Justice Romer.

STRETTON'S DERBY BREWERY *v.* MAYOR OF DERBY.

(*L. T.* Rep., Vol. lxix., n. s. 791.)

This case elucidates the construction of section 19 Public Health Act, 1875, and bears also on section 15.

By the latter section "Every Local Authority shall keep in repair all sewers belonging to them and shall cause to be made sewers as may be necessary for effectually draining their district for the purposes of the Act."

Section 19 provides that:—"Every Local Authority shall cause the sewers belonging to them to be constructed, covered, ventilated, and kept so as not to be a nuisance or injurious to health, and to be properly cleansed and emptied."

The action was brought against the Mayor, Aldermen, and Burgesses of Derby, acting as the Urban Sanitary Authority, by the Brewery Company for an injunction to restrain the defendants from allowing sewage-water or noxious matter to be discharged from their sewers on to the plaintiffs' land or premises or from continuing the said sewer so as to cause a nuisance to the plaintiffs.

The facts of the case are sufficiently embodied and detailed in the decision of Mr. Justice Romer, as follows:—

Many years ago in exercise of their statutory duties the defendants provided a system of sewage drainage for their district, and as a part of that system made the sewer that passes under the road in which the plaintiffs' brewery is situated. The brewery was erected some years after the sewer was made, part of it having been built in 1869, and other parts in 1876, 1880, and 1881.

As the different parts of the brewery were erected the owners for the time being exercised their statutory right and drained into the sewer by communications which had to be and were first approved of by the defendants. These communications, respectively, run to the sewer from the floors of the cellars of several parts of the brewery, which floors are slightly above the crown of the sewer, so that the cellars cannot be flooded from the sewer until the sewer gets filled and a pressure is caused, which forces the contents of the sewer up the communications through the cellars.

On the 26th of June, 1891, a heavy storm occurred which blocked the sewer and drove the sewage up the the plaintiffs' communications through the cellars and flooded the cellars for a short time for a depth of about three feet, and after the flood retired left some two inches or so of sewage matter on the floors of the cellars. This undoubtedly caused damage to the plaintiffs and they complained to the defendants. On the 25th of May, 1892, another but slighter flooding occurred, and on the 28th of June, 1892, there was another heavy storm and a flooding to the extent of about fourteen inches which left a deposit of sewage, whereupon the plaintiffs made further complaints of the damage which they had sustained, the defendants not admitting liability, this action is brought in August, 1892, for an injunction and damages. After the action was commenced there was another flooding on the occasion of a heavy storm which took place on the 11th of July, 1893. Now in considering the liability of the defendants for these floodings and consequent damage it appears to me material to decide some questions of fact. In the first place I find the defendants in constructing their existing system of drainage and in constructing the sewer exercised due care and were not guilty of any negligence: that system as constructed reasonably provided for the district and for the buildings which would have to drain into it. In the next place I find that when the communications between the brewery and the sewer were made and for some years afterwards the sewer was well constructed and sufficient for the purposes of draining the district and could cause no flooding or probability of flooding to the brewery. I also find that the floodings arose not from any want of repair in the defendants' sewer, but owing to the large increase in the last few years in the number of buildings and places in the district which drain into the sewer, if a very heavy fall of rain occurs in a short space of time the existing sewer has become insufficient in size to carry off the sudden influx of water and gets choked and so drives the contents of the sewer up the plaintiffs' communications and into the floors of their cellars, it seemes to me that such floodings arising from heavy falls of rain are likely as matters now stand to occur about once a year and more frequently in the future as the number of drains increases with the further buildings which may be erected in the district drained. I further find that if (as the plaintiffs insist) the floors of their cellars are to remain as low and their communications are to continue to run from those floors then the only way to prevent the liability to flooding is by the defendants constructing a new sewer or a new system of drainage for the district.

Assuming then that it had become the duty of the defendants, as the sanitary authority, to consider the question of constructing, and in due course to construct a new sewer, for a new drainage system, I have to consider whether the defendants, when this action was commenced, or up to the date of the trial of this action, were guilty of negligence, or (as it is sometimes expressed) of want of reasonable care and diligence in maintaining the existing sewer, and in not providing the new sewer or new system of drainage. As to this, I find that the defendants were not guilty of negligence or want of reasonable care. In the first place, it is clear that the defendants, so long as the the present sewer existed, and until its insufficiency owing to the increase of buildings rendered it necessary to construct a new sewer or new drainage system, were not guilty of negligence in maintaining the present sewer, or because until the new sewer was made the owners of the new buildings as they were erected exercised their statutory rights to drain into the existing sewer, so that the question of negligence resolves itself into this, whether the defendants were guilty of negligence in not providing a new sewer or new sewer system, and as to this I come to the conclusion that there was no negligence for the following reasons, as observed by Baron Bramwell in "Buck *v.* Williams" (31 *L. T.*, o. s. 167-8, 27 *L. J.* 361 Ex.). Negligence is a relative term, and must mean negligence with reference to circumstances of time, place or person. Now the negligence of the defendants, if any, is not in omitting to do repairs or small works of that kind which could be speedily done, but in not constructing a new sewer or sewage system for the district in due time after its necessity had become apparent. I am satisfied on the evidence before me that the construction of a new sewer or sewage system, as is requisite, having regard to the size of the town and the configuration of the defendants' district, is a large, expensive and very difficult undertaking and one requiring considerable time before any plan or scheme for the new system could with propriety and in the exercise of reasonable care, be adopted or commenced, and the carrying out of such plan or scheme must of necessity occupy a considerable time. The difficulties in the way of the defendants are great. If for instance the sewer be lowered or enlarged, or if an additional or storm sewer be provided, a difficulty arises as to how the sewage or waters carried down, can be disposed of, and unless some new way were carefully thought out, it might happen that relief might be granted to the plaintiffs, only by flooding the lower part of the town through which the sewer runs, after passing the plaintiffs' premises.

Now it appears that more than a year ago, the defendants considered this question of a new sewer or drainage system, and consulted experts of great eminence who were to report as to what was the best thing to be done under the circumstances, but the report though expected very shortly, has not yet been sent in, owing to the difficulties and magnitude of the case. Under these circumstances I do not think that the defendants can be fairly said to have acted unreasonably or negligently in not proceeding with the construction of a new sewer or new drainage system. It was suggested that they might have suggested the expert sooner than they did, but the first complaint to them was only in June, 1891, when the flooding was caused by a storm of most unusual character, a storm which one of the plaintiffs' witnesses said, was the heaviest he ever saw, and the defendants might well regard this as not likely to recur. There was some evidence of overflows at the brewery before June, 1891, but no particulars were given or dates, except that the overflows were after 1885 and near the year 1890, and no complaint was made about them to the defendants though one of the plaintiffs' witnesses said that he verbally conplained to a nuisance inspector. Then after the overflow of June, 1891, nothing occurs until the floodings of May and June, 1892, and though defendants refused to admit any liability for the damage thereby caused: it must have been shortly after this that they consulted the experts, and under these circumstances I cannot think they were guilty of negligence or of want of reasonable care and diligence in not previously taking active steps in the matter. It is moreover noticeable that the plaintiffs' statement of claim does not expressly allege negligence on the part of the defendants and on behalf of the plaintiffs in opening their case, it was stated that they were not bound to allege or prove negligence.

The question now arises as to whether on the above finding of facts the defendants can be held liable. The plaintiffs put their case in this way, they say broadly that as the sewer was made by and belongs to the defendants, the defendants are liable for the nuisance caused by the sewer to the plaintiffs, whether they have been guilty of negligence or not and are not protected from such liability by any provisions of the Public Health Act or any other Act, and in support of this general proposition the plaintiffs contend: (1) that apart from any statutory duty cast upon the defendents and treating the defendants as strangers who have a private sewer of their own, the defendants must be held liable; (2) that the defendants are liable because they have infringed the provisions of Sec. 19 of Public Health Act 1875, which enacts *inter alia* that "every Local Authority shall cause the sewers belonging to them to be constructed · · · and kept so as not to be a nuisance."

Now with respect to the first contention I cannot see how the plaintiffs can say they are entitled to treat the defendants as strangers. The nuisance to the plaintiffs would not have been caused but for the communications opened by their predecessors in title with the defendants' sewer. No part of the sewage or water in the sewer would have got on the plaintiffs' premises but for those communications which the plaintiffs' predecessors made in exercise of the rights given to them by Sec. 21, Public Health Act, or the corresponding section in a prior Public Health Act (Section 8, Sanitary Act, 1866). It was because the defendants were not strangers, but a public body making and maintaining a sewer for public purposes, and for the benefit of the inhabitants of the district that the above rights were given and that the defendants were bound to allow the communications to be made subject to the mode in which the communications were made being approved. It appears to me, when under and by virtue of statutory duties, works are made and maintained by a public body for the benefit of the public, or a section of the public and a member of the public in exercise of the statutory rights given to him, uses those works and thus suffers damage, the rights of that member and the liability of the public body in respect to such damage are to be ascertained not by considering how matters would stand if the parties could be regarded as strangers but by reference only to the statue under which the works were made, maintained and enjoyed. And to make the public body liable under the circumstances you must find that liability passed upon the public body by the statutes in question either by express provision or reasonable intendment. This brings me to a consideration of the plaintiffs' second contention and the statutes governing the case, and the only statute I need consider is the Public Health Act, 1875.

Now Sect. 19 on which the plaintiffs rely, is in point of wording unlimited as to the liability it casts on the defendants. But it has long since been held—and I take it to be now settled—that by reasonable construction of an Act, such as this, the liability in circumstances like the present, though in form not limited is in fact limited to cases where the Local Authority has been guilty of negligence, or as it is sometimes expressed, of want of reasonable care and diligence, see *Hammond* v. *Vestry of St. Pancras* (ubi. sup. and *Bateman* v. *Poplar District Board* ubi. sup. cases under *Sect.* 72, *Met. L. Man. Act*, 1855) which section is substantially the same as Sec. 19 of Public Health Act. See also *Brown* v. *Sargent* (1 F. & F. 112) a case under Public Health 1848, Sect. 46, which is for present purposes practically identical with Sect. 19 of the present Act. See also on the question of the general principle governing cases like the present, *Blyth* v. *Co. of Proprietors of the Birmingham Water Works* (II. Ex. 781). *Whitehouse* v. *Birmingham Canal Co.* (30 *L. T. o. s.* 156 27 *L. J.* 25 *Ex.*) and the above-mentioned case of *Buck* v. *Williams*. This being so as I have found as a fact no negligence on the part of the defendants, they cannot in my judgment be held liable under Sect. 19. Nor do I find from any other provision of the Public Health Act, nor can I reasonably gather that the defendants are to be liable in a case like the present in the absence of negligence. This disposes of the action, for as no legal wrong doing by the defendants has been established, the plaintiffs are entitled neither to damages nor to an injunction, nor are they (as suggested by plaintiffs' counsel) to call upon the defendants for any such undertaking as was voluntarily given by the defendants in the case of *Att. Gen.* v. *Clerkenwell Vestry* (ubi. sup.).

The action was dismissed with costs.

QUEEN'S BENCH DIVISION.

Before Lord Chief Justice Coleridge and Mr. Justice Day.

BLAKER *v.* TILLSTONE.

(70 L. T. Rep. n. s. 33.)

Under section 117 *Public Health Act,* 1875, *the absence of positive proof that the owner of diseased meat knew of its condition is no bar to his conviction.*

This was a Brighton case and was stated by the stipendiary and other magistrates for the borough. The appellant was a manufacturer of german sausages. The inspector had seized meat unfit for food, and it was afterwards found to be so by a justice of the peace.

There was no evidence that the meat had been seen by the appellant, the purchase and the dealing with regard to the meat having been effected by the machine man in the employ of the appellant. The justices found that at all events the machine man knew of the condition of the meat and if the appellant had no personal knowledge of its condition he might and would have had if he had exercised reasonable care. Upon these facts the appellant was convicted but stated a case for the consideration of the court.

Mr. **Francis Gore**, the counsel for the appellant, argued that it was held in Reg. *v* Sleep (4 L. T., Rep. n.s. 525) under 9 and 10 Wm. III. c. 41, in a prosecution for being in possession of naval stores marked with the broad arrow, that a conviction could not be sustained without proof that the defendant knew them to be so marked. That case governed the present one.

Lord Chief Justice Coleridge: It cannot be denied that in the judgment delivered in the case of Reg. *v*. Sleep, which was a prosecution under a statute of Wm. III. for being in possession of naval stores, there are expressions used which show that the court were of opinion that it was essential to a conviction to show that the defendant knew they were marked with the broad arrow. We have to deal in this case with a different statute and it is different at least in this respect, that it is plain under this statute the magistrate may destroy the property of another person without any inquiry as to whether that person knew that the property so seized was bad meat. That is unquestionable. Then the section goes on to say that after the justice has acted upon his judgment and destroyed the meat "*and*—(not *or*)— the person to whom the same belongs shall be liable to a penalty." Those are the terms of the Act and its object is that people shall not be exposed to eat things that are injurious and that such things shall not be sold. In the present case such a thing was sold and the question is whether it must be proved by the prosecution that the defendant knew the article to be unsound. Perhaps it would be a good enough answer to the question to say that it is obvious such a view would render the enactment nugatory because a man might easily avoid personal knowledge of the state of the article and go on habitually selling bad meat with impunity and we ought not if we can help it to construe the section in such a way as to render the enactment useless.

Conviction affirmed.

QUEEN'S BENCH DIVISION.

Before **Lord Chief Justice Coleridge**, and **Justices Matthew** and **Collins**.

THE CONSERVATORS OF THE RIVER THAMES *v*. THE SANITARY AUTHORITY OF THE PORT OF LONDON.

(L. T. Rep. Vol. lxix., n. s. 803.)

The Public Health (London) Act, 1891 (54 & 55 Vict. c. 76), enacts:

Sect. 4. (i) *On the receipt of any information respecting the existence of a nuisance liable to be dealt with summarily under this Act, the Sanitary authority shall, if satisfied of the existence of a nuisance, serve a notice on the person by whose act, default, or sufferance, the nuisance arises or continues, or, if such person cannot be found, on the occupier or owner of the premises on which the nuisance arises, requiring him to abate the same* *within the time specified in the notice, and to execute such works and do such things as may be necessary for that purpose, and, if the Sanitary authority think it desirable (but not otherwise) specifying any work to be executed;* (iii) *provided that* (*b*) *Where the person causes the nuisance cannot be found, and it is clear that the nuisance does not arise or continue by the act, default, or sufferance of the occupier or owner of the premises, the Sanitary authority may themselves abate the same and may do what is necessary to prevent the recurrence thereof.*

This was a case stated by one of the Metropolitan Police magistrates. The respondents were the London Port Sanitary authority: the appellants the Thames conservators. The Thames conservators were summoned by the Port authority to remove as a nuisance filthy accumulations in Limekiln Creek.

Limekiln Creek extends inwards from the river 400 to 500 feet. It is an open tidal creek, and the accumulation complained of was stated to be made up of the following matters: (*a*) Matters originally in suspension deposited from the water a portion of this being a certain quantity of sewage from the metropolis; (*b*) a portion consisting of matter which floated in on the surface of the water, such as oranges, vegetables, and remains of dead animals, which were left when the tide receded; (*c*) a portion consisting of hay and straw lost from barges in process of discharging in the creek; (*d*) a portion derived from soap and water, and other matters derived from two premises adjoining the creek; (*e*) a portion consisting of matters thrown overboard from barges. The main portion of the accumulation was caused by the acts of numerous persons who could not be identified.

The appellants contended: (*a*) That it was not proved that the soil of the said creek ever vested in the appellants; (*b*) That even if it did so vest it was vested in them in a qualified manner only, namely to the extent and for the purposes, and subject to the responsibilities and liabilities contained and mentioned in the Thames Act, 1857 to 1883; (*c*) That a construction of the general language of the interpretation clause 141 of the Public Health (London) Act, 1891, in the way contended for by the respondents, amounted to construing it as an implied repeal of the provisions of the said Thames Act defining the extent of the responsibilities of the appellants, and that the said section ought not to be construed as including them; (*d*) That upon the true construction of secs. 52 and 63 to 69 of the said Thames Navigation Act, 1866, and of secs. 3 and 5 of the said Thames Conservancy Act, 1867, and of sec. 18 of the said Navigation Act, 1870, the appellants were impliedly absolved from the obligations sought to be imposed upon them by the respondents; (*e*) That upon the true construction of the said Thames Acts, 1857 to 1883, of the Public Health (London) Act, 1891, the appellants were not owners of the said creek within the meaning of the said last mentioned Act; (*f*) That the appellants under and by virtue of sec. 52 of the said Thames Conservancy Act, 1857, were for all purposes material to this complaint in the same position as the Crown had been in, and were not therefore liable under the Public Health (London) Act, 1891, not having been named therein; (*g*) That it being clear that the said nuisance did not arise or continue by the act, default, or sufferance of the appellant, the respondents were themselves compellable to abate the said nuisance under and by virtue of sec. 4, sub-sec. 3 (*b*) of the said Public Health (London) Act, 1891, and as such, the proper persons to abate the same; (*h*) That the removal of the dead bodies of the animals referred to in para. 12 was a gratuitous act which the appellants were under no statutory obligation to do.

LORD CHIEF JUSTICE COLERIDGE: I am of opinion in this case that the contention of the Conservators is right, and that no such duty is imposed upon them as has been suggested. If such a duty is imposed upon them it must be by the Public Health (London) Act, 1891 (54 & 55 Vic., c. 76). It is true as I understand that there is a nuisance here, but not a word to suggest that the nuisance was created by any act or default of the appellants. Now the Public Health (London) Act, 1891, enacts by Section 4 that where a nuisance exists the Sanitary Authority shall serve a notice on the person by whose act, default, or suffrance the nuisance arises or continues requiring him to abate the same. That has not been done here because the person cannot be found. The section then provides that if such person cannot be found the notice shall be served on the owner or occupier of the premises. In this case the respondents have served a notice upon the appellants, requiring them as owners to abate the nuisance complained of; but as part of this section there must be read with it the proviso (*b*) which enacts that where the person causing the nuisance cannot be found, and it is clear that the nuisance does not arise or continue by the act, default, or suffrance of the occupier or owner of the premises, the Sanitary Authority may themselves abate the same, and may do what is necessary to prevent the recurrence thereof. It is not necessary now to enter into a discussion as to whether the word "may" mean "must," as that has been decided to be so in "Julius *v*. Bishop of Oxford" (42 *L. T.* Rep. n. s. 546, App. Cas. 214) and the cases following that decision. It is easy to suggest cases in which great injustice might be done if any other construction was put upon the section and the proviso. Supposing one of the great sewers burst and flooded certain premises there would be an owner or occupier and also a nuisance, but the owner or occupier could not be required to abate such a nuisance. The plain meaning of the proviso is, that before an owner is liable to abate a nuisance it must be clear that such nuisance is caused by the act or default of the owner of the premises. The Sanitary Authority has a general power of removing nuisances themselves when the person causing them does not do so, and if the words of the proviso are not satisfied the Sanitary Authority must abate the nuisance. If the state of things arose where a person causing the nuisance could not be found, and it was not caused by the person on whom the notice was served, the Sanitary Authority would have to take the necessary steps to abate the nuisance. I might rest my decision upon that point alone, but as the other question has been argued before us I will deal with that as well. It is admitted that in the whole of the

Thames Conservancy Act there is no word about the removal of nuisances in this part of the river, though there are such provisions in other Acts which deal with particular areas of which this is not one. It is, therefore, a very strong argument that where that duty is not cast upon the appellants, it is not intended to be. There are provisions as to what money is to be received from them and in what manner it is to be spent, and if it is misapplied the Conservators would become personally responsible for such moneys. So if they applied the money coming into their hands for removing what might be a nuisance when they had no authority to do so they would be personally liable. The cases which have been quoted to us are distinguishable from the present case. In the "Company of the Proprietors of Margate Pier *v.* Town Council of Margate" (20 *L. T.* Rep. n. s. 564) it was decided that under a particular set of Acts persons who had no beneficial ownership in a harbour were liable to remove a nuisance therein. In the "Conservators of the River Thames *v.* the Victoria Station and Pimlico Railway Co." (19 *L. T.* Rep. n. s. 734 *L.* Rep. 4 C. P. 59) Parliament was invoked to enable the Railway Co. to build a bridge across the river Thames, and in doing so the Company encroached upon the land of the Conservators. This land had been scheduled in the Act obtained by the Company and the lands clauses Consolidation Act, 1845, was incorporated therewith, and it was held that the Conservators were entitled under those Acts to compensation for the land taken by the Company. To that extent and for the purpose of those Acts the Conservators were the owners of the land on which the bridge was built, and Parliament authorised by those Acts the Conservators to do what otherwise they could not have done. It seems to be clear that there is nothing in those cases which have been cited that is inconsistent with the contention of the Conservators in the present case although the Conservators are for certain purposes the owners and occupiers of the foreshore they are not so for the purposes of the Public Health (London) Act, 1891.

This appeal must therefore be allowed.

MR. JUSTICE MATHEW: I am of the same opinion and agree with the construction put by my Lord upon Section 4 of the Public Health (London) Act, 1891. When the Thames Conservancy Acts are examined it is clear that the Conservators hold lands for specified purposes, and there is an obligation upon them not to allow the land to be used for any purpose that would interfere with the navigation of the river. They have different powers in different parts of the river and there are careful provisions as to the appropriation of the money received by them to different purposes. It has been said that the Public Health (London) Act, 1891, imposes a further liability upon the Conservators, but I do not agree with that construction and think such a construction would be unreasonable. If it had been intended that such further liabilities should be imposed upon them there would have been some provision for raising money to enable them to carry out such duties; but there is no such provision. I think therefore this appeal must be allowed.

MR. JUSTICE COLLINS concurred. Appeal allowed.

Appeals under the Sale of Food and Drugs Acts.

Three important appeals have been recently heard before the Queen's Bench—the effect of which is briefly as follows:—

In Bakewell *v.* Davis. An analyst certifiying to abstraction of fat should confine himself to the fact in his certificate of the abstraction, and not add any opinion as to whether such abstraction is fraudulent or an adulteration. This question is one for the Court, not for the analyst. If he does so, nevertheless such opinion will not invalidate the certificate, but be treated as unauthorised comment or mere overplusage.

In Hiett (appellant) *v.* Ward (respondent) it is made clear that should an inspector acting under the powers of the Amended Act, 1879, and causing a sample to be delivered to him, whether there is a genuine sale or compulsory sale, and whether the vendor receives the money or not, is a mere variance and not of the essence of the charge, even though the summons may be for selling milk to the prejudice of the purchaser.

In Jones (appellant) *v.* Bertram (respondent) it appears that should milk be sold to a retailer and a written warranty delivered, the said written warranty does not protect the retailer from prosecution under the Act unless he can clearly prove that he sold the milk as he received it.

QUEEN'S BENCH DIVISION.

BAKEWELL *v.* DAVIS.

(*L. T.* 69 n. s. 832.)

Sale of Food and Drugs Act.

The appellant was convicted under section 6 of the Food and Drugs Act.

The analyst's certificate upon which proceedings were instituted was as follows:—"I am of opinion that the said sample contained the parts as under, or the percentage of foreign ingredients as under: 22 per cent. of fat less than natural. Observations: The abstraction of fat is a fraud, and may possibly be injurious to health. No change had taken place in the constitution of the article that would interfere with the analysis."

The magistrates convicted.

On appeal it was argued by Mr. Poland, Q.C., that the certificate was invalid, because the analyst was bound to give a certificate substantially in the form provided by the schedule to the statute. The summons did not sufficiently state the particular of the alleged offence. The following cases were referred to:—"Barnes *v.* Cliff," 38 *L. T.*, n. s. 570; "Rouch *v.* Hall," 44 *L. T.*, n. s. 183; "Lane *v.* Collins," 52 *L. T.*, n. s. 257; "Hotchkin *v.* Hindmarsh," 65 *L. T.*, n. s. 149.

The Court held that the observations were unauthorised and ought not to have been made, but that they were a mere statement of opinion by the analyst and did not invalidate the certificate.

Appeal dismissed.

Before JUSTICES MATHEW and COLLINS.

JONES, APPELLANT *v.* BERTRAM, RESPONDENT.

(*Times*, Feb. 16th, 1894.)

The Sale of Food and Drugs Act, 1875, s. 25, states that if the defendant in any prosecution under the Act proves to the satisfaction of the justices or Court that he purchased the article in question as "of the same nature and quality as that demanded by the purchaser, and with a written warranty to that effect, and that he had no reason to believe at the time when he sold it that the article was otherwise, and that he sold it in the same state as when he purchased it, then he shall be disharged," &c. In the present case the charge was, that Bertram, a refreshment contractor at the Crystal Palace, had, as alleged on the 12th of October last, sold to the prejudice of the purchaser, milk which was not of the nature and quality demanded by the purchaser—that is, there being 36 parts in 100 of added water. The case stated that on the 12th of October five churns of milk were delivered at the Exhibition by a servant of one Morish to the servant of Bertram with this warranty, "Five churns, 15 gallons. Warranted pure milk, from which the cream has not been extracted, or any water or other substance added to such milk when delivered." The five churns were received by a servant of Bertram, who tested the milk with a lactometer, by which it appeared that the milk in four of the churns indicated ·32, the point given as the standard for pure milk, while in the fifth it only indicated 26. The milk, however, in the fifth churn being afterwards tested, was found exceptionally good. The milk now in question, however, was taken from one of the four other churns. A servant of Bertram took out of one of them six quarts, which were poured into an urn on the counter, and which was in the care of Bertram's servants except for five minutes at a time, when the keeper of the next bar would have charge, and Bertram's servants proved that the milk was not tampered with to their knowledge. Of the six quarts two were sold, and about 7 in the evening the appellant purchased a sample of milk from Bertram's bar, which was found upon analysis to contain 36 per cent. of added water, though another sample afterwards taken was found to be only deficient in butter fat, and no mention was made of added water. The magistrate found that Bertram had purchased the milk under a written warranty of its purity, and had no reason to believe that when it was sold it was otherwise, and, so far as the evidence went, they said, "the state of the article had not been altered by Bertram or his servants." But they found that the milk was adulterated as stated, and that, in fact, the sale was to the prejudice of the purchaser, and they did not find that, in fact, the milk when sold was in the same state as when received by seller. The magistrate dismissed the summons on the ground that Bertram had purchased the milk as genuine and with a written warranty to that effect, and that he had no reason to believe that at the time when he sold it it was otherwise, "and that there was evidence before me from which I might infer that, assuming that it was not sold in the same state as when he purchased it, the change was not made by himself or his servants, or to his or their knowledge." But he stated a case on the question whether the decision was right in point of law.

Mr. Justice Mathew, in giving judgment, said the conditions of the section as to warranty had been satisfied. It was not proved and was not found that the milk was in the same state when sold to the customer as when it was received. There was strong evidence that the milk when delivered to Bertram corresponded with the warranty, but when it was sold to the prosecutor it had clearly been adulterated. It was then for the seller to show not only that he had received it under a warranty of genuineness, but that when sold it was in the same state as when received. But this the magistrate had not found. The case, therefore, fell short of what was required to relieve the seller, and the magistrate ought to have convicted him.

Mr. Justice Collins was of the same opinion.

Appeal allowed.

QUEEN'S BENCH DIVISION.

Before Justices Mathew and Collins.

BURROWS v. SMITH.

(*Times*, February 6th, 1894.)

In the sale of Partridges or other Game by one dealer to another, there is an implied warranty that the food sold is fit for use; if not fit, the Vendor is responsible.

On October 9th the defendant, a dealer at Newcastle, telegraphed up to the plaintiff, a dealer in game in London.—"Send me 80 old partridges" by goods train. The birds were sent on the same day by passenger train, arriving about the same time, and they reached the defendant next day, about noon, but, as he said, "quite putrid." He telegraphed up to plaintiff—"Birds alive with maggots; shall I return or sell on your account?" The plaintiff telegraphed in reply—"Birds sent in good condition according to order; hold you responsible." The plaintiff sued in the City Sheriff's Court for the price of the birds (£4 13s. 4d.), and the defendant set up that they were uneatable and unmerchantable, and offered evidence in support of it, while the plaintiff offered evidence that the birds were fresh. The Judge, however, held that there was warranty, the case of "Burnby v. Bollett" (16 M. and W.) being cited, which, he said, was in point, it being held there, he said, that where a butcher buys meat in a market and sells it there is no warranty that it is fit for food. There is no implied warranty and no fraud. It being urged that according to this view dealers might sell rotten game, he said:—"According to my experience they have been doing this for the last 34 years," and he repeated that there was no implied warranty and no fraud. The inspector of nuisances proved that the partridges were putrid, and he obtained an order from the magistrates for their destruction. The Judge, however, adhered to his view of the law, and gave judgment for the plaintiff for the price.

The defendant appealed.

Mr. A. **Baker** appeared for the defendant, and pointed out that the case cited by the learned Judge was not in point.

The **Court** called upon the counsel for the plaintiff.

Mr. C. C. **Scott** cited the case of "Beer *v.* Walker" (46 *Law Journal* Reports), where it was held in a similar case that there was an implied warranty that rabbits were fit for food and would be so when they arrived. Here, however, the birds were sent by a passenger train, which had not such facilities for ventilation, &c., as the vans in goods trains. Our answer to the application for a new trial is that there was no breach of the implied warranty, even assuming such a warranty. The train probably arrived early in the morning, and the birds were kept some hours in a close place. There must therefore be a new trial.

The **Court** allowed the appeal, and gave judgment for the defendant.

Mr. Justice Mathew said the case cited showed that there was an implied warranty in such a case, and, indeed, an authority was hardly necessary to show that there is such a warranty on the sale of food. There was evidence, however, that when the birds arrived they were putrid and uneatable. The Judge, however, held that there was no warranty, and decided the case on that ground. There must be judgment for the defendant.

Mr. Justice Collins concurred. The Judge clearly decided on his view of the law, which was erroneous. When asked if dealers might sell partridges which were putrid he answered that if they did they were not responsible. The view of the law being erroneous, there must be judgment for the defendant.

Appeal allowed.

FORTHCOMING MEETINGS OF THE INSTITUTE.

A SESSIONAL MEETING will be held at the **Parkes Museum**, on **Wednesday, April 11th, at 8 p.m.**, when a Paper will be read on "The Construction of Roads and Streets from a Sanitary point of view," by **Lewis H. Isaacs**, F.R.I.B.A., ASSOC.INST.C.E., Surveyor to the Board of Works for the Holborn District. The Paper will be followed by a Discussion. Tickets for the admission of visitors may be had on application to the Secretary of the Institute.

LECTURES ON METEOROLOGY IN RELATION TO HYGIENE.

A suggestion was made to the Royal Meteorogical Society, and by them to the Sanitary Institute, that many Medical Officers of Health and others would be glad to gain some further information on the important question of Weather and Climate in relation to Health and Disease.

As this involved both Meteorology and Hygiene, it was thought well by the respective Councils that the two Societies should jointly arrange a course of Lectures upon this subject.

The following Six Lectures deal with some of the principal factors and points for consideration, and will, it is hoped, be the means of spreading much useful information upon the subject.

Fee for the Course, Half a Guinea.

Fellows, Members, and Associates of both Societies are admitted to the Lectures without payment, but cannot introduce friends.

The Lectures will be given in the Parkes Museum, on Mondays and Thursdays, at 8.30 p.m.

April 23. "Instruments and Observations and their Representation." G. J. Symons, F.R.S.

" 26. "Temperature of Air, Soil and Water." H. R. Mill, F.R.S.E.

" 30. "Barometric Conditions and Air Movements." R. H. Scott, M.A., F.R.S.

May 3. "Moisture, its Determination and Measurement." W. Marriott, F.R.Met.Soc.

" 7. "Climate in Relation to Health, and Geographical Distribution of Disease." C. Theodore Williams, M.A., M.D., F.R.C.P.

" 10. "Fog, Clouds and Sunshine." F. Gaster, F.R.Met.Soc.

Tickets for the Course can be obtained of the Assistant-Secretary of the Royal Meteorological Society, Great George Street, S.W., or the Secretary of The Sanitary Institute.

THE AUTUMN CONGRESS AND EXHIBITION OF THE INSTITUTE.

The Institute has accepted an invitation from the Lord Mayor and citizens of Liverpool to hold its next Congress and Exhibition in that city from September 24th to 29th. The Health Exhibition in connection with the Congress will remain open until October 20th.

The work of the Congress will be divided into three Sections and five Conferences, viz.: Section I.—Sanitary Science and Preventive Medicine; Section II.—Engineering and Architecture; Section III.—Chemistry, Meteorology and Geology.

Conference of Medical Officers of Health; Conference of Municipal and County Engineers and Surveyors; Conference of Sanitary Inspectors; Conference of Ladies on Domestic Hygiene; Conference on the Sanitation of the Passenger and Mercantile Marine Service.

The Council invite Papers on subjects relating to Health and Sanitary Science. Papers are limited to twenty minutes in reading. A short abstract must accompany every Paper, both for the convenience of the Press at the Congress and for insertion, subject to the approval of the Council, in the Journal of the Institute, should it not be deemed desirable to publish the Paper *in extenso*. No previously published Paper can be read. The acceptance of Papers, and the days on which they are to be read, are determined by the Council before the beginning of the Meeting. The Council reserve the right of refusing any Papers sent in; and in the case of those accepted, the reading of them must depend upon the time at the disposal of the Meeting. Papers read at the Congress cannot be published by the Authors, except by permission of the Council. The Council reserve to themselves the privilege of printing any Paper read at the Congress, either wholly or in part, or of refraining from the publication thereof, if they see fit. The Addresses and Papers or Abstracts thereof are usually printed by the Institute in London before the meeting of the Congress, and may be purchased from the Secretary of the Institute during the Congress. Authors should forward their manuscript by book post *on or before August 24th*, addressed to the Secretary, Sanitary Institute, 74A, Margaret Street, W.

Official Delegates to the Congress have been already appointed by—

The County Councils of:

Lindsey, Lincolnshire.
Staffordshire.

The County Boroughs of:

Birkenhead.
Birmingham.
Bootle.
Bristol.
Cambridge.
Cork.
Crewe.
Exeter.
Glasgow.
Huddersfield.
Lincoln.
Liverpool.
Mansfield.
Rochdale.
Wolverhampton.
Wrexham.

The Urban Sanitary Authorities of:

Barry and Cadoxton.
Brigg.
Bromley.
Gillingham.
Heywood.
Holyhead.
Kidderminster.
Leigh.
Linlithgow.
Maidstone.
Runcorn.
Southport.
Swindon.
Walker.
Warley.
Wavertree.
Wick.
Winsford.

The Rural Sanitary Authorities of:

Barnstaple.
Barton Regis.
Caistor.
Carlisle.
Holywell.
Wirrall.

Accrington and Church Outfall Sewerage Board.

Hull and Goole Port Sanitary Authority.

Mutford and Lothingland Union.

Shillelagh Union.

Pembroke Township.

CALENDAR FOR APRIL, MAY AND JUNE.

APRIL.

2 M. Exhibition Committee, 5 p.m.
2 M. Lecture to Sanitary Officers, London, 8 p.m.
4 W. **Ordinary General Meeting, 4 p.m.**
6 F. 7 S. Examination, London.
11 W. Finance Committee, 4 p.m.
11 W. Council Meeting, 5 p.m.
11 W. Sessional Meeting, 8 p.m. Major L. H. Isaacs, F.R.I.B.A., on The Construction of Roads and Streets from a Sanitary Point of View.
23 M. Museum Committee, 5 p.m.
23 M. Lecture, Meteorology in Relation to Hygiene, 8.30 p.m. On Instruments and Observations and their Representations. G. J. Symons, F.R.S.
26 Th. Lecture, Meteorology in Relation to Hygiene, 8.30 p.m. Temperature of Air, Soil, and Water. H. R. Mill, M.D., F.R.S.E.
27 F. 28 S. Examination, Durham.
30 M. Lecture, Meteorology in Relation to Hygiene, 8.30 p.m. Barometric Conditions and Air Movements. R. H. Scott, M.A., F.R.S.

MAY.

3 Th. Lecture, Meteorology in Relation to Hygiene, 8.30 p.m. Moisture, its Determination and Measurement. W. Marriott, F.R.MET.SOC.

MAY (*continued*).

4 F. 5 S. Examination, Bristol.
7 M. Exhibition Committee, 5 p.m.
7 M. Lecture, Meteorology in Relation to Hygiene, 8.30 p.m. Climate in Relation to Health and Geographical Distribution of Disease. C. Theodore Williams, M.A., M.D., F.R.C.P.
9 W. Finance Committee, 4 p.m.
9 W. Council Meeting, 5 p.m.
10 Th. Lecture, Meteorology in Relation to Hygiene, 8.30 p.m. Fog, Clouds, and Sunshine. F. Gaster, F.R.MET.SOC.
14 M. *Whit Monday.*
18 F. Examination Committee, 5 p.m.
25 F. 26 S. Examination, Hull.
28 M. Museum Committee, 5 p.m.

JUNE.

1 F. 2 S. Examination, Local Surveyors, London.
4 M. Exhibition Committee, 5 p.m.
13 W. Finance Committee, 4 p.m.
13 W. Council Meeting, 5 p.m.
15 F. Examination Committee, 5 p.m.
22 F. 23 S. Examination, Plymouth.
25 M. Museum Committee, 5 p.m.

GENERAL NOTES.

QUERIES.

"FROZEN SEWAGE."

Query.—"A," the owner of some exhausted brick-fields in an urban sanitary district has levelled the pits, and in event of frost diverts a portion of the town sewage by placing a dam in the open sewer which flows near for flooding the ground for the purpose of a skating rink. The extent of the ground is about three acres, is some two hundred yards from any dwelling house, and is flooded to the depth of two or three feet, and water is run on whenever required to make up for soakage. The town is supplied with water from wells, and it may be added that the sewer also carries the surface water.

Is this calculated to be a nuisance and injurious to health, and if so in what way? No drains are put in at the bottom of the rink to carry away the water after the frost is over, nor is any provision made for getting rid of it except by running it off into an adjoining dyke in a pit.

G. R.

Answer.—I am of opinion that as long as the temperature was at the freezing point or below the fact of nuisance could not be established.

It therefore only remains to be considered as to whether there is any difference at the time of the thaw between the field flooded with sewage and an ordinary example of broad irrigation. I fail to see myself any essential distinction, save that in broad irrigation you have a system which is intended to be permanent, but in this you have a temporary matter. In both cases the question of nuisance or not is to be determined not by theory but by fact. In other words your correspondent must wait until the thaw comes and establish his nuisance by the complaints of residents, by his own sense of smell, and by any illness which may be presumed to be caused thereby.

A. W. B.

CREMATION.—In the Annual Report, just issued, of the Cremation Society of England, of which Sir Henry Thompson is President, the Council offer to the supporters and friends of cremation their congratulations on the further success of the Society's efforts during the past year. During the year 101 bodies were cremated at the society's crematorium, St. John's, Woking, Surrey, as compared with 104 during 1892. The decrease, however, is only apparent, because a crematorium now exists near Manchester, where 30 bodies were burnt during the past year, as against three during 1892. Altogether during 1893 131 bodies were cremated in England, as against 107 in 1892. Since 1885, when the crematorium was started at Woking, 458 bodies have been disposed of there. The number of cremations in the successive years were as follows:—1885, 3; 1886, 10; 1887, 13; 1888, 28; 1889, 46; 1890, 54; 1891, 99; 1892, 104; 1893, 101. When the crematorium was first started at Woking many of the local residents were highly indignant, now a cremation arouses not the least excitement or interest.

THE HERMITE SEWAGE PROCESS.—Attention has of late been devoted to attempts to use electricity for the purification of sewage. An apparatus designed to accomplish this has been constructed by M. Hermite, a French inventor whose name is known in connexion with electric bleaching, and has been working on a small scale at Worthing for the last few weeks. M. Hermite proposes to lay on to each house by pipe from a central reservoir partially electrolyzed sea water, which is to be used to flush the drains in the same way as ordinary water is used at present. The current is passed through sea-water, and, according to M. Hermite, decomposes the magnesium chloride, forming an "oxygenated compound of chlorine," which he thinks is hypochlorous acid. At Worthing this fluid is being supplied to a row of fourteen houses in West-street. The solid matter of the sewage is stopped by a straining vessel placed at the junction of the drain from these houses with the main sewer, while the liquid part runs away in the form of a clear fluid, which is inodorous of anything but chlorine, and is said to be completely sterilized of bacteria. There are no available figures for its actual working cost, because no installation of it on a practical scale is as yet in existence. It is evident that the adoption of the system, whether in a seaside or inland town, would entail a heavy initial outlay, for it would necessitate the duplication of the existing water arrangements. Two pumping stations—one for drinking water and the other for the disinfectant—would be required, together with two sets of reservoirs, mains, cisterns, and fittings. As to the action of the disinfecting fluid on fittings and piping, hypochlorous acid is a very active substance, which is capable of attacking iron, and even the zinc of galvanized cisterns.

A WATER EXPERIMENT.—Colonel Heywood, the Engineer to the City Commission of Sewers, has laid before that body a description of the artesian well recently sunk in New Street, Gravel Lane, by the Commission, under his superintendence. It is now eight years since the Commission first resolved to take means to supply water independently of the New River Company, their attention having then been called to the heavy charges made for water in the City. After two years' work, the contract had to be annulled owing to legal and other difficulties, and a fresh contract was accepted. On March 3, 1890, the work was re-commenced, and in 1891 the contract depth of 350 feet was reached. The well then yielded but 900 gallons per hour, and on the advice of Colonel Heywood the boring was sunk until it reached in all about 512 feet from the surface. The well now yields 70,000 gallons in 24 hours or about 3,000 gallons per hour. The cost of the work in all has been £5,610. All kinds of geological formations—gravel, sand, clay, rock, &c.—had been passed through in the progress of the work. The artizans' dwellings served by the new well contain 241 separate tenements and 535 rooms and 36 shops, and there is a permanent water storage capacity of 14,366 gallons by means of tanks on the roof.

ARSENIC IN APPLES.—Three children were recently poisoned at Keswick as the result of eating an apple which they bought for a penny. One of the children died. The apple is described as a large rosy-cheeked one, and the doctor who was called in stated that the poisoning was due to arsenic, which is used to preserve the apples.

RELICS OF JENNER.—An interesting and extensive collection of relics of Dr. Edward Jenner, the discoverer of vaccination, which some months ago were on view at Bristol, has now been brought to the First Avenue Hotel, in Holborn, and is open to the inspection of visitors at a charge of one shilling. The collection includes several portraits, many letters from crowned heads and other distinguished persons, a quantity of Jenner's manuscripts, the documents conferring upon him the freedom of the cities of London and Dublin, many works of art, and other articles which belong to him, many drawings of the vaccine pustule in its various stages, the lancets used by Jenner in vaccinating, and other matters. The collection is the property of a gentleman who married a lady of the Jenner family, and has added to her possessions by purchase. He is now desirous to dispose of the whole to the Royal College of Surgeons or other public body, so as to guard against dispersal. Any profits arising from the exhibition will be shared with some of Jenner's descendants, who have fallen into circumstances which would render such help acceptable and useful to them.

Factories, Workshops, and Mines.—The Press Association understands that Mr. Asquith, following up the policy he has pursued since he came into office as Home Secretary, may be expected shortly to introduce a fresh series of administrative reforms in various departments under the control of the Home Office. The recent additions to the staff of factory inspectors is likely to be supplemented by the appointment of further inspectors, male and female, and also of more inspectors' assistants. These assistants, who will number 15, are intended to be active men of practical knowledge and experience. One of their special functions will be to follow up the lists of outworkers, which are now required to be kept by manufacturers of all kinds of wearing apparel, cabinet and furniture makers, upholstery manufacturers, file cutters, and electroplaters. It is hoped in this way to check and prevent some of the worst evils of the sweating system. The bulk of the present assistants are now engaged in London, where they have been placed under the charge of Mr. Lakeman, one of the most experienced of her Majesty's inspectors, who has been specially detached for this purpose. In addition to the central offices in London, Glasgow, Birmingham, and Leeds, which are designed to be recognised centres of factory inspection in their respective districts, where all concerned, whether employers or employed, can call to give, or ask for, information, proposals will, it is said, be made during the present year to provide additional offices for the like purpose at Manchester, Liverpool, Blackburn, Sheffield, Newcastle, Nottingham, Norwich, Bristol, Southampton, Plymouth. Swansea, Edinburgh, Dundee, Dublin, and Belfast. In addition to the special rules already issued for various industries which are more or less dangerous to health, based upon the reports of special committees consisting of inspectors, medical men, chemical and other experts, it is found that further legislation is necessary to give full effect to some of the recommendations contained in certain of these reports. In this connection the Home Secretary will probably seek to amend the Factory Acts and to deal with unreasonably long hours of labour in unhealthy industries, also to place open quarries, as well as underground quarries, under the supervision of inspectors of mines. Two or three additional inspectors will be appointed in that department. The most recent steps taken by the right hon. gentleman on the lines indicated are—(1) The institution of exhaustive inquiries in respect of laundries, the linen industries of Belfast, the Merionethshire salt mines, and the Sheffield grinders; (2) the scheduling as occupations dangerous to health of the red, orange, or yellow lead smelting, the turning and enamelling of iron hollow ware, electric accumulator works, flax mills, and linen factories; and (3) the appointment of a committee to consider the subject of statistics relating to factories and workshops and mines and minerals.—*Times, March 24th*, 1894.

Institute of Certificated Sanitary Inspectors.—At the Parkes Museum, Margaret-street, Cavendish-square, on Friday evening, 23rd March, the first annual meeting of the Institute of Certificated Sanitary Inspectors was held. Professor Blyth presided, and Sir D. Galton and a number of other eminent sanitary authorities were present. The chairman gave a short history of the foundation of the society and a report of the work it had accomplished. The society has for its main object the protection of the interests of holders of the certificate of competency as sanitary inspector. It has received the formal recognition of The Sanitary Institute, the offices of which it has been permitted to use as its place of meeting. Professor Blyth then delivered an address entitled "The Education, Past, Present, and Future, of the Sanitary Inspector." After a brief historical retrospect, he traced the influence of The Sanitary Institute in the cause of education, showing the remarkable progress in facilities for self-instruction from the first establishment of the examination in 1877 and the first course of lectures in 1886 to the present date, and gave a list of the towns which, owing to the influence of the Institute, had established special courses of instruction. He also alluded to the facilities for object lessons which students possessed in the metropolis, The Sanitary Institute's system of lending out books to students, and the valuable reports of the medical officer to the Local Government Board. He considered that there should be an extension of the system of technical training for some of the posts connected with the inspection of factories. He disagreed with the present system of patronage in appointing factory inspectors. The lecturer approved of the appointment of lady sanitary officers. A scheme of self-education was then drawn out for the guidance of the student who wished to devote himself to the study of hygiene, and the lecturer concluded by stating the position of the Society of Certificated Inspectors. A vote of thanks to the chairman terminated the proceedings.

THE PRODUCTS OF BACTERIA—The International Medical Congress at Rome has attracted distinguished authorities. An important series of researches carried on by Professor Von Schroon at Naples are to be laid before the congress. He is completing and giving exactitude to the researches with to tubercle and to cholera, and adding to the progress of the science of bacteriology, especially in relation to the prevention and treatment of disease. He has evidence to show the nature of the products of the bacilli of phthisis, cholera, and hydrophobia. The demonstrations of the crystalline products of several varieties of bacillus open up questions of the greatest importance to mankind, and lead to the hope that the coming congress will do much to encourage those who are endeavouring to advance medicine by experimental research.

AMOUNT OF FLUSH WATER FOR WATER CLOSETS.—In addition to the six Metropolitan Sanitary Authorities (St. Giles, Islington, Paddington, Shoreditch, St. Marylebone, St. Saviour's Southwark), who wrote to the Local Government Board urging the desirability of allowing a larger amount of water than two gallons for flushing water closets; the following authorities who have under consideration the report made by the Committee of The Sanitary Institute upon this question, have expressed their approval of the suggestion that the amount of flush water should not be less than three gallons: Camberwell Vestry, Chelsea Vestry, St. Luke's Vestry, St. Mary Newington Vestry, Wandsworth Board of Works.

KENNY & CO., PRINTERS, 25 CAMDEN ROAD, LONDON, N.W.

Volume XV.—Part II.] [July, 1894.

JOURNAL

OF

THE SANITARY INSTITUTE.

THE CONSTRUCTION OF ROADS & STREETS FROM A SANITARY POINT OF VIEW.

By LEWIS H. ISAACS, F.R.I.B.A., Assoc.Inst.C.E.,

Surveyor to the Board of Works for the Holborn District.

Read at Sessional Meeting, 11th April, 1894.

In a paper which I had the honour of reading at a Meeting of the Society of Arts on the 13th December last on the subject of Carriage Way Pavements for large Cities, the opening paragraph was as follows :—

"The art of paving the streets of large cities and towns is of ancient date, and the association of well paved roads with the public health is more intimate than is generally supposed," and further on I said, "for a long time the influence of a good or bad system of carriage way paving upon the health of the inhabitants of our large cities and towns was either ignored entirely, or was regarded as only of secondary importance; but I think I shall be in accord with the prevailing views upon this subject if I give it absolutely first place in the list of the objects to be attained."

I propose now further to consider this subject, limiting my observations however to such as are pertinent to the title of the present paper.

It may be laid down that the points to be aimed at to insure a good carriage way pavement from a hygienic point of view are the following:—

1. It must effectually prevent the rising of exhalations from the ground on which it is super-imposed.
2. It must be non-absorbent of moisture, so as to give off the least possible amount of offensive effluvia from its own surface.
3. It must be well drained, both longitudinally and transversely, so that water cannot remain on its surface.
4. It must be easily cleansed.
5. It must be as free from dust and mud as possible.
6. It must be as noiseless as possible.

Let us consider these conditions in the order in which they are placed, and first let me endeavour to explain what I mean when I say that a good carriage way pavement should preclude the possibility of offensive exhalation from the ground underneath its surface.

For a long time the custom prevailed in the development of building estates in the environs of large towns to dig out the subsoil of streets where clay suitable for making bricks or good gravel was met with, and to fill in the cavities thus created by road detritus or even less sanitary materials. The greed of the speculating builders in this respect was so pronounced that they have been known to deal in the same manner with the portions of the building plots allocated to the gardens in the rear of the houses. Their gain was two-fold. Not only was the gravel or clay thus obtained at once a source of profit, but the cavities created by the excavations formed available shoots for the scrapings and sweepings of the roads, and for all kinds of rubbish, filth, and refuse, for the use of which shoots considerable sums of money were paid.

Further, in all our large cities there is a stratum or section of ground lying immediately under the carriage way pavements, in which the gas mains and services have been laid, such stratum being charged with coal-gas which has leaked into the ground from defective pipes and joints. This stratum which might appropriately be termed the pest-stratum, gives off when opened up by pick or shovel, the most offensive odours, and in the formation of a sanitary pavement it becomes necessary so to arrange its construction as effectually to prevent these odours from escaping into and polluting the atmosphere of our streets. This can be best accomplished by a bed of concrete of sufficient depth and excellence of material to seal completely all that is below it. The remedy now suggested can only be applied to streets whose surfaces are paved with granite, wood or asphalte; as macadam or gravel roads do not admit of the employment of such a sub-stratum. If any one of my audience should be in ignorance of the existence of this pest-stratum, let him stand over a trench that is being dug for laying gas or water mains in any part of a city where gas has been supplied since its introduction, or even for a shorter period, and he will soon have the most convincing proof of the accuracy of my assertion. Gas engineers object to have the laying of their pipes interfered with. Nay, they go further and say that the modern concrete foundation for carriage way pavements should not be permitted, as it gives escaping gas no chance of making its presence known to those on the street surface, and there is danger of its finding its way into the sewers and vaults, and the consequent risk of explosion therefrom. If this contention, however, were followed up to its logical conclusion it would mean that the pavements should accommodate themselves to the gas mains, and not the gas mains to the pavements, a view of the matter not likely to be endorsed by the general public. It is satisfactory to know that modern legislation has conferred powers upon local authorities to stop the practice to which I have referred, of converting the subsoil of our streets into rubbish heaps prior to the advent of the road-maker.

2. It must be non-absorbent of moisture. This is the most important desideratum, as upon its accomplishment or otherwise the sanitary success of a pavement will mainly depend. The question then arises, what conduces to, or causes the absorption of moisture by a pavement? The answer is either the nature of the material of which the pavement is composed, or the mode and manner in which it is laid. Thus, wood is, of itself, an absorbent material, but granite, which from its density is barely absorbent, may be made to absorb and conduct water by the imperfection of the joints or other unscientific manner in which it is dealt with when used for a carriage-way pavement. Macadam or gravel may also be regarded as being open to grave objection as paving materials on the score of the facilities they afford for the absorption of any moisture which may fall upon a carriage way pavement of which they form the crust.

3. The pavement must be well drained both longitudinally and transversely. Taking these in inverted order, I would observe that ranking next in importance to its foundation is the contour or cross section of a carriage way. The longitudinal gradient of the road or street in a great degree controls this, it being necessary to give a more convex contour to a level or flat street than to one having a good fall. The material used for the paving has also to be taken into consideration, gritstone requiring more camber than granite, and wood than asphalte. No fixed rule can be given for the cross-section of a carriage way pavement; but, it may be assumed that about

1 in 30 to about 1 in 40 would be sufficient, according to the gradient of the road and the material employed.

4. The pavement must admit of being easily cleansed. This condition is imposed upon municipal engineers, not only on the score of public hygiene, but for the safety of the horses that have to travel, and draw loads over the roadways. I cannot better emphasize the importance of this branch of the subject than quote the following observations from the paper which I read at the Society of Arts before referred to.

"The art of cleansing the surfaces of our roads is but imperfectly understood in this country. The fault does not entirely lie with our municipal engineers; nevertheless, we must cross the English Channel in order to see what systematized and efficient street cleansing can do in order to make street surfaces not only innocuous but agreeable both to sight and smell. Paris, Berlin, Vienna, even Buda Pesth, although the last-named is almost on the confines of civilization, can give us most useful lessons in this particular. In Berlin the main streets (asphalte) are thoroughly washed every morning by gangs of cleaners. During the day the men and boys work singly, but should a good shower of rain fall they immediately assemble and make use of the opportunity to wash and clean the streets again.

"That is what I term systematic and efficient street cleansing. I cannot shut my eyes to one thing that is involved, namely, a copious supply of water that can be used, so to speak, utterly regardless of cost. This supply should be for purely municipal purposes, such as the extinguishing of fires, the washing of streets, and other paved surfaces, and the flushing of the public sewers. It follows, therefore, that it need not be filtered nor dealt with by the expensive processes necessary for the water used for domestic purposes. No such supply exists in London, however much better off provincial towns may be in that respect. On the contrary, in London the water is retailed to the municipal authorities at prices which are almost prohibitive, and the operations connected with efficient street cleansing are severely handicapped thereby. Let me dwell upon this branch of my subject just a little longer. The supply of water I am pleading for is for municipal purposes only. It should be supplied at the cost of all London, and should be at the service of all Londoners, without further expense than the repayment of principal and interest on first charge, and cost of necessary maintenance, and the duly authorized municipal bodies should be at liberty to take it for municipal purposes where, when, and as often as they pleased. This would render feasible what I have always maintained is the only rational manner of dealing with the paved surfaces of a town, to treat them as you do the paved surfaces of your houses when you desire to cleanse, namely, to wash them. You could render the hygienic effect of this treatment more pronounced if such simple disinfectants as certain of the residuals of gas manufacture were added to the water when atmospheric conditions rendered that course necessary.

"I am informed that a gallon of soluble creosote, or a gallon of liquid carbolic acid added to 2,000 gallons of water, would prove in each case an invaluable disinfectant at but trifling cost. As regards wood pavements and the offensive miasmatic odours now given off therefrom, the effect of the suggested washing and antiseptic treatment would go a long way to remove the distrust in which this form of pavement is now held, and restore it somewhat to public favour."

5. It must be as free from dust and mud as possible. Obviously considerations other than hygienic require the fulfilment of this condition, not the least important of which is economy, for as both dust and mud are the result of abrasion, and consequent loss of the material of which the paving is composed, the smaller the quantity of these two objectionable matters created the greater the economy. From the hygienic point of view the absence, or comparative absence, of dust and mud as resultants from the traffic on carriage way pavements, is of primary importance. Nor can we afford to lose sight of such small economies as the wear and tear of the dress of pedestrians, and the operations of washing and renovating the painted surfaces of our house fronts, with which this part of our subject is closely associated.

6. It must be as noiseless as possible. Doubtless it occurs to a good many of my audience that this condition which I have placed last should have occupied the foremost place in the list; and to the inhabitants of cities where there is a large amount of vehicular traffic, the consequent wear and tear of the brain and tension of the nerves, are considerations that cannot be disregarded. Even from so low a standpoint as £. s. d., anything which reduces the money-earning capacity of the bread winner must receive its proper amount of attention when dealing with this subject, and there can be no doubt that the noise resulting from horses shod with iron shoes drawing vehicles on wheels with iron tyres, often travelling at top speed, must have a most injurious effect on the brains and nerves of those who have to live in towns under such conditions.

It has occurred to me that if objection be taken to some of the so called noiseless materials for road paving on the score of slipperiness, the desired result might be arrived at in another way, namely, by shoeing our horses with india-rubber pads, and substituting the same material for wheel tyres. Action in regard to the latter has already been taken, for no modern hansom cab is now considered complete unless provided with noiseless tyres.

I have endeavoured to lay down the salient points to be remembered in the construction of roads and streets from a sanitary point of view. Let me now enumerate the pavements which are usually met with in the streets of our large cities and towns, with the view of testing how these pavements comply with the hygienic conditions imposed. These pavements divide themselves into two classes, namely, those which are laid in parallel courses at right angles to the kerbs, and those which are without joints—longitudinal or transverse. The first embraces gritstone, granite setts, and wood blocks, whilst asphalte, macadam, and gravel roads constitute the second.

For the purposes of this paper gritstone and granite setts may be considered together, as the observations applicable to the one are nearly if not entirely applicable to the other.

As materials for paving street surfaces they have been proved to be both durable and economical, and if laid on a sufficient concrete foundation will effectually prevent the rising of exhalations from the ground on which they are placed. Though they are almost non-absorbent they lend themselves to the conveyance of moisture below their surfaces by reason of the numerous joints in laying the setts, and after some amount of wear holes are formed on the surface, especially at or near the joints. This result militates against the effectual cleansing of streets thus paved, and to this great defect must be added another, namely, that, of all the materials ordinarily employed by the municipal engineer in paving the roadways of large towns granite or gritstone setts are the noisiest. Neither are these materials free from objection on the score of dust and mud. Less harmful than macadam or gravel in this respect, the abrasion consequent on traffic, especially when the carriage ways thus paved have commenced to suffer from wear, creates an amount of dust in summer and mud in winter which does not give them first rank as paving materials from a sanitary point of view.

WOOD PAVING.

The largely increasing employment of wood for paving purposes, is probably due to its being, up to the present, absolutely the least noisy material to hand, and with the exception of asphalte, it gives the minimum of traction.

As the wood blocks require to be laid on a proper and sufficient bed of concrete, they may be held to comply with the first of the desiderata aimed at in a hygienic pavement, namely, prevention of the rising of exhalations from the ground underlying the same. There are no difficulties, moreover, in draining wooden pavements, and if water be liberally used in cleansing their surfaces, they afford facilities in this respect greater than granite or gritstone setts. Compliance with the last-named recommendation will also ensure their comparative immunity from dust and mud.

It is only when we regard wooden pavements in connection with our second condition that we see where they fail from a sanitary point of view, namely, their absorption of moisture and consequently of the urine, horse droppings, and the other offensive matters that fall on carriage way pavements in large cities. These matters penetrate into the fibre of the wood blocks producing some amount of fermentation, which according to the temperature more or less charges the atmosphere with miasmatic exhalations. Evidence as to this is afforded by one's sense of smell, but it may be interesting to note what foreign and colonial authorities have to say upon the use of wood as a paving material.

The Board of Health Committee of Washington in a report upon this subject, remarked that probably four-fifths of the newly-paved streets of their city were paved with wood varying in kind, some having been treated with antiseptics before being laid, and that within three years from the time they were laid every one of them gave more or less evidence of very rapid decomposition, and some of them had decayed so rapidly as to give rise to a mass of dangerous putrefaction; that, moreover the broken surface of the pavement above-mentioned had allowed the lodgment of an immense quantity of animal and vegetable filth, impossible even to calculate, between and under the blocks of wood, not only greatly increasing the putrefying mass, but adding to the rapidity of its decomposition; and that from the said decomposition gases arose, fungi and infusoria developed, which, entering the air breathed, were poisonous, engendering zymotic diseases, such as typhoid, malarial and intermittent fever, dysentery, diphtheria, &c.

Turning now to Australia, we find that the Board appointed by the Legislative Assembly of New South Wales in 1885, after carefully considering all accessible evidence, and examining the foundation and obtaining analysis of the blocks to ascertain if they had been penetrated by water, expressed the opinion that wood was a material which could not be safely used for paving unless it could be rendered absolutely impermeable to moisture, and so laid that while the entrance of water between the blocks was rendered impossible, the separation of the fibres at the surface by the concussion of the traffic was also effectually prevented. These conditions had nowhere, to the knowledge of the Board, been fulfilled. In their city (Sydney) no attempt to fulfil them had been made, and the analysis showed that the blocks in actual use had absorbed an amount of organic filth which was large in comparison with the short time during which they had been laid, and which was distributed through the blocks in such a manner as showed that their complete impregnation was only a matter of time.

The Board then proceeded to express an opinion that the above defects were irremediable by any process then known, and recommended that the use of this material, and every known method of construction, should be discontinued in the streets of Sydney. This result was arrived at after the use of hard blocks, such as cedar, blue gum, black butt, spotted gum, &c., and not comparatively soft woods as in England.

It can be readily understood that both in America and Australia which are timber producing countries, if it had been possible to have spoken differently of the results of employing wood as a paving material, the authorities would only too gladly have done so, and nothing but the stern facts of the situation caused them to adopt such plain out-spoken language as that contained in the reports from which I have quoted.

However great, therefore, may be the claims of wooden pavements upon our gratitude for their noiselessness, it is not only possible but probable that we have obtained this undoubted boon at the cost of our producing an atmosphere highly charged with elements not conducive to perfect, or even approximately perfect, salubrity. On the score of hygiene a wooden pavement cannot be said to be an ideal pavement, nor can we regard it as the pavement of the future. It will, doubtless, hold its own until superseded by a pavement as noiseless as, but more in compliance with the Sanitary requirements of the present day than, itself.

Asphalte Pavement.

We come now to the consideration of the second group of carriage way pavements, namely, those laid without joints, either longitudinal or transverse, and foremost amongst these comes asphalte. Asphalte is a bituminous limestone, or pure carbonate of lime impregnated with bitumen. It is found as a rock, and contains about 90 per cent. of carbonate of lime, and 10 per cent. of bitumen. Great care should be exercised that the latter is in its right proportion, since if it exceeds 12 per cent., the asphalte becomes soft and wavy under the influence of the sun, and where only 8 per cent. is present the asphalte is somewhat brittle, and therefore liable to crack.

Asphalte, like wood, requiring a concrete foundation may be held to comply fully with our first condition, namely, the prevention of the rising of exhalations from the ground on which it is placed. Further, it is non-absorbent of moisture owing to its impermeability, and of all the materials at the engineer's disposal for paving purposes yet known, it gives off the least amount of effluvia from its own surface. It consequently takes the highest rank on the score of hygiene. It admits of being well drained, and, in addition to this, it may be stated in its favour that it is more easily cleansed, and dries more readily than any other pavement. Being laid without joints it is free from jolting, is comparatively noiseless, and is readily repaired in a very short time.

Though not directly within the scope of this paper, yet the complaint so frequently urged against asphalte as a paving material, namely, its slipperiness, admits of a cure which if employed has excellent hygienic results. I allude to the frequent and liberal use of water for cleansing purposes to which I referred when dealing with No. 4 of our conditions. It is unnecessary for me to add anything to what I have already advanced under this head, unless it be that not only would the surfaces of our roads be the gainers by this process but the volume of water conveyed into the public sewers thereby would prove of infinite advantage for flushing purposes especially in a dry season such as that of last year.

MACADAM AND GRAVEL ROADS.

In the suburbs of our cities these forms of pavement are largely in vogue, arising no doubt from their comparative cheapness of cost in the first instance, especially in the case of gravel roads, where the material forming the crust of the carriage way can often be procured in excavating for the foundations of the houses abutting on the roads.

But whatever their merits on the score of economy in the first instance, they fail to comply with nearly every one of the conditions we have laid down as necessary to ensure good carriage way pavements from a hygienic point of view. Thus whilst affording no protection against the rising of exhalations from below, being very absorbent of moisture, they retain and give off the offensive effluvia arising from any malodorous droppings on their surface. Neither do these roads admit of being thoroughly cleansed by the application of water, which I contend is the only efficient method of cleansing street surfaces.

In wet weather the materials of which these roads are formed are converted into mud, to the serious discomfort of pedestrians, whilst in dry weather they are absolutely unhealthy owing to the dust produced by the abrasion of the surface materials, which dust being largely associated with organic matter, is carried by the wind for the inhalation of those living in or passing through the roads so paved.

Beyond comparative cheapness the only advantage which macadam or gravel has over paved streets is the comparatively less noise produced by the vehicular traffic passing over the surface. In all other respects they are pavements which the municipal engineer will do well not to avail himself of in the urban portions of the districts committed to his charge.

It would appear therefore from this analysis that up to the present, asphalte may be safely pronounced to be the most desirable material for the crust of our carriage way pavements from a sanitary point of view. I had hoped to have proved this conclusively by the results of bacteriological examinations of the air of various London streets paved respectively with granite, wood, and asphalte. The period of the year when these examinations were made did not admit of the obtaining such absolutely exhaustive demonstrations as to warrant my placing them before you. I undertook the duty of writing this paper in the month of January last, and from that time up to the middle of March there had been a large amount of rainfall.

Now it may be accepted as an axiom that bacteria cannot rise of their own accord. The material on which they happen to be must dry completely and must crumble into fine dust, the dust and micro-organisms being then distributed by air currents.

It is to be observed that wood paving is much longer in drying than either granite or asphalte, and in the winter can rarely be dry enough to give off much dust. During the experiments which I caused to be made, it was noted that on no occasion were the wood pavements selected really dry, that is to say, dry enough to give off dust. It was felt therefore that the results of these experiments were not reliable, and they are not presented to you. Had they been taken during the drought of last summer they would have probably shewn the existence of such a number of micro-organisms in the air over the surfaces of streets so paved as would have gone far to establish in the public mind the conviction that however great the charm of a wooden pavement on the score of noiselessness, that boon can be purchased at too high a price if hygiene has to be sacrificed thereto.

Furthermore, I put myself in communication with Professor Frankland with the view of his undertaking a series of chemical analyses of the air at given heights above the different kinds of pavement used in London; but in reply he stated that I should be disappointed with the results, as he had shown, many years ago, that the air in the middle of the City of London scarcely differs in chemical composition from that which is met with in the middle of Switzerland. I am bound to say I was not prepared for such a finding, but coming from so high an authority it is immediately and entirely accepted.

I can scarcely expect that all the views set forth in this paper will be accepted by my audience; indeed, I hope for the sake of the discussion which I trust will follow its reading that they may not be. But however much we may differ on the principles I have endeavoured to enunciate, we shall be all agreed that the municipal engineer can have no safer motto to follow in this department of his many important duties than the saying of the great Lord Beaconsfield:

"SANITAS SANITATUM, OMNIA SANITAS."

The Chairman, Sir DOUGLAS GALTON, moved a vote of thanks to Major Isaacs, and said that the paper opened a large field for discussion. He pointed out that with an impervious surface under the roadway such as was described by Mr. Isaacs to prevent exhalations rising from the ground beneath, it would be necessary to cut off the side walls of houses from the street by means of open areas, in order to prevent these exhalations from rising into the houses, where they would be more injurious than in the open air. With regard to wood pavement, he remembered that many years ago, between 1840 and 1850, a wood pavement was laid down in Oxford Street and remained for some time, until complaints received from the jewellers and silversmiths in Oxford Street that the emanations from the roadway tarnished their silver goods, caused it to be taken up. This effect of wood pavement was now neutralized to some extent by the tar put over the blocks. Last summer was a good illustration of one of the drawbacks to a wood pavement. The Local Authorities had not sufficient water at their command for the effectual cleansing of the roads, and in consequence the surface was covered with horse dung dust which was constantly being blown in one's face. With regard to the experiments as to the presence of bacteria in the air mentioned by Mr. Isaacs, if he had referred to Dr. Russell's and Dr. Angus Smith's experiments, he would have found there was a material difference between the air of London and that of Mont Blanc. Experiments in Paris showed that there were large numbers of bacteria at the openings into sewers, from which it would seem that the presence of sewers would tend to increase the number of bacteria in the air; but on the other hand, the experiments carried out under Mr. Binnie in London Sewers, showed that there were fewer bacteria in the sewers than in the streets. It would seem therefore, according to Mr. Binnie, that it was healthier to live in sewers.

Mr. Rogers Field, M.Inst.C.E. (London), said that Mr. Isaacs had confined himself to the sanitary aspect of the question, and very properly kept in the background the technical points relating to construction. The effect of roads on the surrounding air was a matter of much more importance than was usually attached to it. With small cities it did not so much matter, as one could easily get away from the bad air, but with such an enormous city as London had now become, the condition of the air became a vital point. He had lived nearly all his life in Hampstead, and, when a boy, used to walk about two miles across fields on his way to school in London. Now, those two miles were entirely composed of streets, which made an enormous difference. It is now a matter of difficulty to get away from London air. With regard to the exhalation, from what Mr. Isaacs had called the "pest stratum," he had that very day passed an open trench in Victoria Street, and the smell arising from this trench was very bad. Nevertheless he agreed with Sir Douglas Galton that if you have a bed of impervious material to seal all below it as suggested by Mr. Isaacs, there is a great danger of the smell from the "pest stratum" finding its way into the houses, and this was a point which should not be lost sight of. With regard to Dr. Frankland's statement that there was no difference in the condition of the air in the city of London, and the air in the middle of Switzerland, he could only say that if chemical observation showed this, it did not give the true result. Irrespective of the scientific fact mentioned by Sir Douglas Galton, the sense of smell showed that there was a difference. He had noticed, when walking, a wonderful difference in the air on leaving the low-lying ground and coming to the hills of Hampstead, and this was especially noticeable at night time. The nose is a very delicate instrument for detecting impurities in the air. Professor de Chaumont used the sense of smell in testing ventilation, and found by experiments that the increase of close and disagreeable smell detected by the nose corresponded with the increase of foul organic matter which is estimated by the amount of carbonic acid present. He hoped Major Isaacs would pursue his investigations and present a paper to the Institute giving the results arrived at. He thought the question of mud was not sufficiently considered. In London, doors that fronted on the street would be found to be covered with mud. A notable instance of this would be found in the new Sessions Court, Westminister, built only a year ago, where the stonework was spotted all over with mud in wet weather, notwithstanding that the pavement was of wood. This showed how important the thorough washing of streets was. He considered the opinion expressed in Australia and the United States on the subject of wood pavement most important, they were both wood producing countries, and he thought it a very significant fact that they should pronounce against its use for the purposes of roadways.

Mr. W. N. **Blair**, Assoc.M.Inst.C.E. (St. Pancras), said it was evident from the tone adopted by the lecturer that he inclined toward asphalte as the most sanitary pavement; but although it was desirable to secure the most hygienic roadway, the questions of economy and of durability must not be lost sight of. The absorbent capacity of a road depended not only on the nature of the wood adopted, but also on the method of jointing. A cement joint might be durable and impervious, but a lime joint was not much better than sand, as it easily got crushed into mud. A pitch joint was the best—it was quite impervious, and had been widely and successfully used in the provinces. There had been a few failures of course, but it was only by means of failures that the way to success could be learnt. He agreed with the lecturer as to the necessity of washing the pavement, but at present it was a matter of impossibility, on account of the large cost of the water necessary. It might not be desirable to do this with soft absorbent woods, as it tended to deteriorate the nature of the wood, and result very quickly in disintegration. Mr. Isaacs had opposed wood pavement, as if there were only one kind of wood. He pointed out that there was great difference in qualities. The porosity of yellow deal blocks was high, as they absorbed 23·44 per cent. of moisture after seven days immersion in water; the Jarrah and Karri Australian woods absorbed 10·71 per cent. and 7·77 per cent. of water respectively; while a good Gault brick would absorb 10 per cent. of its weight in water. This would show that the Australian wood was good in comparison with even a very dense brick. He advised close joints filled with bitumen, which by reason of its elasticity would allow the wood to expand, without causing displacement of kerbs and footways; and as the fibre of the wood could not be so easily brushed and rendered springy, there would be less liability to splashing. Some of the finest soft wood pavements in the country were to be found in the parish of Marylebone, being smooth and jointless. He thought that the reports from Australia as to some examples of wood paving not being satisfactory must be due to the work having been done improperly. In America he had heard of wood having been laid down in logs, but the failure in such a case must not condemn the wood. There existed evidence that wood pavements in Australia had been laid twelve years under traffic, and were good still. Many reports spoke highly of wood pavements in Australia, and he thought the wood was worthy of adoption. In comparing wood with asphalte, it must be borne in mind that asphalte offers great difficulty and danger to horses. The opinion of horse owners which had been taken in 1889 showed 1,000 in favour of wood to 100 in favour of asphalte. He thought macadam was not good from a hygienic point of view.

Mr. **Chas. Mason**, Assoc.M.Inst.C.E. (St. Martin-in-the-Fields), thought that Mr. Isaacs should have given more details as to the different qualities of wood for paving purposes in London. Certainly no *perfect* carriage-way pavement had as yet been invented, and this was a point to which every municipal engineer would do well to turn his attention. Asphalte was undoubtedly the best pavement from a hygienic point of view, but the question of securing a good foothold for horses should have every consideration, great cruelty being often exercised in forcing horses up inclines paved with asphalte. He contended that no gradient of 1 in 60 and over, should be paved with asphalte, at the same time for courts and alleys and all thoroughfares where there is little traffic and good gradients exist, asphalte should be adopted as the paving material. Then again, serious and valid objection is often raised against asphalte on account of the noise caused thereon by the traffic which tries the nerves of those occupying offices and places of business abutting on the streets. The best form of wood paving consists in laying the blocks with close joints, creosoting the wood, and when laid, seeing that the roadway is kept properly scavenged. This method has been proved to give an excellent pavement. He had himself tried it in the Strand and the North side of Trafalgar Square, and he felt sure these roads would compare favourably with any in London. It would be found that horse droppings did not adhere to creosoted wood so readily as to the plain deal blocks. With regard to the cleansing of roads, London must not be compared with Paris. There the roads were undoubtedly cleaner, but it must be borne in mind that the climate of Paris was quite different to that of London, the former being bright and clear. Part of Charing Cross had been recently laid with uncreosoted wood, but it was found not to be so clean as the creosoted pavements. The extracts quoted by Mr. Isaacs from Australian papers were not complete without fuller details of the pavings. Failure was often due to bad system of laying rather than to the paving material. The Australian woods appear to most nearly approach a perfect pavement, they were least permeable, hardest, easiest to clean, and lasted longest, and he looked forward to the time when these hard woods will have been laid a sufficiently long time to enable more complete statistics thereon to be compiled than we have at present.

Mr. ARTHUR E. COLLINS (Borough Engineer, Reading) stated that he had laid many miles of granite paving, and agreed with Mr. Blair as to bituminous joints; where such joints are used the roads are less noisy than with cement. He ventured to point out to Mr. Isaacs that macadam did admit of the use of concrete foundations, he having used it with most satisfactory results in the construction of a new road on a clay bottom. He remembered a bad gas explosion in a house bordering on a road paved with an impervious surface, which was due to a leak under the road. Granite macadam was rarely slippery.

Mr. HOOPER said he thought Mr. Isaacs had overlooked the question of climate; a surface that was suitable for a hot climate would not suit a temperate one. In Washington and Sydney he thought the wood was probably unseasoned and not cleaned, the road laid in loose blocks and not creosoted. With regard to dust, one had only to examine a ray of light on a sunny day, to see that it was a composition by no means nice. With this powder entering the lungs, it was not difficult to see how easy it was for bacteria to enter. Alum had been suggested as a disinfectant. It would certainly be desirable, and if roads were properly washed, the quantity of dust would be diminished, and if dust could be suppressed altogether it would be a very good thing.

Mr. E. G. **Mawbey**, Assoc.M.Inst.C.E. (Leicester), agreed with Major Isaacs that asphalte was best from a sanitary point of view, and if horses were properly shod for it, the difficulty would be overcome. One should hesitate before condemning it. In small towns where very little was laid, horses did not easily get accustomed to it, and there were not such facilities for repairing it. Asphalte was certainly cheaper in the first place than Australian wood, and he thought cheaper in the long run also. He could mention a street in London where that wood had only been laid about four years, but it was now so bad as to severely jolt one passing over it in a cab. With regard to laying Jarrah wood, he had in one particular street made experiments in making joints. In the first length he had laid the blocks with close joints and grouted them with creosote oil and pitch; next with close joints grouted with cement; next with quarter-inch joint racked with shingle and cement grouted; next same width of joint filled with gravel and grouted with creosote and pitch; and he had found the close joints, creosote and pitch grouted, to be the best. If you had open joints the edges became worn down, and the paving formed into ridges and furrows. He thought Jarrah wood ran asphalte close as to being non-absorbent. He gave it preference in provincial towns. In Leicester a street was laid with soft wood, which in time became so bad that ladies refused to go down it in wet weather, in consequence of which complaints poured in from drapers and others. Jarrah wood was at length laid, and the complaints ceased. In the matter of creosoting, he strongly supported Mr. Mason; the cost was about one shilling per yard extra for five-inch blocks. The blocks should not be merely dipped, but should be placed in a big cylinder and a vacuum created, which would extract all moisture from the blocks, then the creosote oil should be allowed to rush in, and the pressure increased by the use of a force pump. He was surprised that London still kept to cement joints; all Northern towns now used creosote oil and pitch. Cement must not be used with creosote, as it would not set. He had invented a pavement of his own, which he had called Asphalte Bedded Paving. It consisted of a bed of concrete four inches thick, on this a one-and-a-half inch layer of tarred gravel, then half-an-inch of fine tarred gravel, then three-inch granite cubes which were paved into the live asphalte, racked up with granite chippings, and grouted with creosote oil and pitch. This would not be found so noisy as ordinary granite paving, would not splash, and was liked very much in Leicester.

Mr. **John Phillips** (London), said, as the oldest of the Municipal

Engineers of the Metropolis of fifty years ago, I beg to offer the following suggestion with regard to laying down blocks of creosoted wood paving with close joints. After about every twelve courses of the paving-blocks had been laid, I would, with a straight wrought-iron joist, as it were, placed against each outer course of the blocks, and with two or three hydraulic jacks placed against the joist, press all the courses of blocks so close and tight together that the whole of them would be almost as a solid body; and rain-water would not pass down at the joints and soak and soften the concrete foundations. I think by this means a more perfect and durable wood paving would be obtained.

Mr. C. TEMPERLEY (London), said Major Isaacs had given information, dated 1883, from Australia; he had information, dated 1893, which showed that the use of wood in Sydney and Melbourne was increasing largely every year for pavements. Originally the blocks were laid with open joints, which system was found unsatisfactory; now close joints had been adopted, and the courses laid diagonally. He possessed some blocks of Karri wood that had been in use twelve years, and they showed that the moisture had only penetrated a quarter-inch from the surface. He would be glad when Mr. Isaacs continued his experiments, if he would kindly test the air outside Mudie's Library, where there was asphalte, and in Fleet Street, where the pavement was of soft wood.

Mr. LEWIS H. ISAACS, in reply, expressed his appreciation of the vote of thanks which had been passed, and said that the writing of the paper had given him very considerable satisfaction, although he knew there were many points involved which the title of the paper did not allow him to touch upon. He was much obliged to the Chairman for calling attention to the fact that he had not submitted any plan for the prevention of the percolation of coal-gas into the sewers and vaults by the employment of concrete for the substratum of carriageway pavements. The best remedy for the existing state of things would be to lay the gas and water mains, as well as the electric wires, in properly constructed subways, beneath the surface of the streets, with side walls of such thickness as would effectually prevent any exhalation from the gas mains escaping from the subways. To Mr. Rogers Field, also, he was much indebted for his criticisms on the paper, especially for the remark that, in order to test the existence of the pest stratum beneath the carriageways of large cities and towns, one must always get to the leeward of any trench that had been opened in a main thoroughfare. He agreed with Mr. Field that, although the composition of the air might, chemically, be almost the same in the centre of London as in the mountains of Switzerland, yet, from actual experience, it could not be denied that the air of a town, or suburb of a town, of five thousand inhabitants only, was very different from that inhaled by the inhabitants of a city with a population numbering five millions. Mr. Blair, Engineer to the Parish of St. Pancras, alluded to the fact, that he (Mr. Isaacs) had not referred to the subjects of durability and economy in treating of the relative merits of the different classes of pavements brought under review in his paper; but, here again, he had to call attention to its title, which actually restricted him to the consideration of those points alone embraced in the sanitary view of the question. Mr. Blair had called attention also to the different classes of wood that had been used for paving purposes, and very correctly remarked that the hard woods which had been recently imported into this country from Australia, namely, Jarrah and Karri wood, had met the objection as to the absorption, and consequent insanitary nature of the material. But here, again, another difficulty cropped up, for strange as it might seem, it was possible to have wood of too hard a nature; and this had been proved conclusively in the parish of Kensington, where the Vestry had been memorialised to take up and remove a sample pavement, laid down in one of the leading London thoroughfares, of Jarrah and Karri wood, on the ground that the density of the wood was so great as to cause the noise of vehicular traffic to be almost as unbearable as if the paving material had been stone. Mr. Mason, Surveyor of the Parish of St. Martin's-in-the-Fields, whose experience in the laying of wood pavements in such thoroughfares as the Strand and Trafalgar Square, entitled his opinion to be received with the highest respect, had likewise gone into the question of the different kinds of wood pavements, and all his remarks were exceedingly valuable, although they were not limited to the standpoint upon which the paper had been written, namely, the construction of carriageways from a sanitary point of view only. This again debarred him (the speaker) from going into many of the points raised by Mr. Mason as to gradients, joints, &c. And the same remarks would apply also to the observations made by Mr. Mawbey, Engineer to the Corporation of Leicester, who, likewise, must be regarded as an eminent authority in this matter. The observations of that gentleman as to the relative values of cement and other forms of grouting were exceedingly practical, and municipal engineers present on that occasion would have their stock of information on this subject very much increased by the remarks addressed to them by Mr. Mawbey. Mr. Hooper's observations as to the climatic influences upon wood and other pavements were also most interesting. He (Mr. Isaacs) could not conclude his remarks without again expressing his regret at not being able to put before the meeting the result of the bacteriological examination which he had caused to be made of the air over the different classes of pavements in the London streets, but he hoped, in the course of the ensuing summer, to obtain further results from similar experiments, and he might at some later date forward the results of such experiments for the information of members of The Sanitary Institute.

Correspondence received after the Meeting from E. W. HUDSON, F.S.I., A.R.I.B.A.

The importance of clean streets and roads in regard to the health of the inhabitants of towns and cities, has been recognised fully in this and other capitals of Europe. In our own case it gave rise to the Sanitary Enquiry of 1842, the Health of Towns Commission, 1844, the Metropolitan Sanitary Commission, 1848, the General Board of Health, 1850, and the Society of Arts (private) Commission, 1874, whose reports dealt in all cases more or less with the subject; and it is worthy of note that, notwithstanding the fact that Sanitary objections have been used as weapons of war in the battle of the pavements, the result has not been, in my opinion at least, the survival of the fittest, and that the lesson which should have been learned from such exhaustive reports has been ignored, and we are to-day in England adopting largely, and with increasing precipitancy, the insanitary pavement which has prevailed in the United States for many years, and is there now being abolished for rock.

The Report of the Society of Arts Commission was a very comprehensive digest of the sanitary and insanitary natures of various pavings, and it deserves careful study by Municipal Engineers, who are so strangely at issue on this point, and I may venture to say very few of them know of its existence. It tells us that at that period, twenty years ago, 1000 tons of horse droppings were daily deposited in the metropolis, that the variously created dust and dirt entailed upon the inhabitants a washing bill of £5,000,000 annually. That there is a foul deposit of dust or mud from this aggregation of dirt, upon ourselves, our houses, and our furniture, everybody knows, and that such dust is doing great mischief to our throats and lungs is affirmed by the faculty, and cannot be too largely proclaimed. Engineering details of carriage-ways are beyond the scope of this discussion, as is also the consideration of the various mechanical contrivances for street cleansing, but the evils which must arise from the use of wood—be it deal, pine, eucalyptus, or what not, creosoted or otherwise—will, I believe, most seriously increase the mortality of the future.

To return to the Society of Arts Commission. The report sets forth that wood was put aside by the General Board of Health on account of its permeability; that it is necessary to emphasize this objection on account of the "dangerous state of ignorance and incompetency of the authorities" by whom such considerations are not entertained or are disregarded. (Vestries and their professional advisers to-day are disregarding this objection in a still greater degree than obtained when this was written.) It continues: "Hospital gangrene frequently follows washing of plain wood floors with water, and dry rubbing is prescribed to avoid the evil. Impregnation of the wood with mineral matter to preserve it from decay may diminish these evils, *but nothing as yet tried prevents the fibres being separated, and the absorption of dung and putrescent matter by the wood.*"

Examination of blocks showed that while the upper portions were dry the lower portions were saturated with urine.

From Paris the testimony of Mons. Foussagrives, Professor of Hygiene, is adduced. He says: "I am convinced that a city with a damp climate, paved entirely with wood, would become a city of marsh fevers."

(Miasma and malaria are terribly frequent in the U.S.A. to-day, and there is still much wood to be found, though asphalte has advanced since 1874 by leaps and bounds. The Commissioners of Public Works, New York City, were convinced even then of the insalubrity of wood, and objected to it on account of the offensive and unhealthy effluvia emitted from it, as well as upon economic grounds. To-day they are largely using Belgian "Setts" in lieu of, and in preference to, asphalte in Fifth Avenue. At Chicago, Detroit, &c., there is the same reaction.

Depend upon it, in a country where wood is the cheap and ready material it would always be used, were there not the strongest reasons against it. Asphalte, it has been proved, will not stand a hot climate, and rucks up with heavy traffic. Even last summer in London its "billowyness" was apparent during the unusually high temperature.

I regret that Dr. Richardson should have specified wood paving of any kind for his imaginative city, "Hygeia," but he describes it as "wood paving set in asphalte." Sir R. Rawlinson, too, set forth, in a letter to *The Times*, how wood blocks should be laid, and advocated a system of felt layers under and between the courses—which method every pavior has now discarded.

Of all pavements asphalte is the best from a sanitary standpoint, and if horses were shod scientifically, so that the frog of the foot came in contact with the surface, there would remain but one objection to it, viz., that it would not stand a heavy traffic like that at Liverpool, or near the London Docks. In spite, however, of opposition from the great carrying firms, Pickford, Barclay & Perkins, the London General Omnibus Company, and the great Railways, and *malgré* petitions for abolition of asphalte to the City Corporation, they will, since they tried it twenty-five years ago, "use no other."

The reference to Liverpool leads me to notice a paper read eighteen years ago, before the Polytechnic Society there, by Mr. Dawson, C.E. First in regard to the noise of granite paved streets (of which material 165 miles out of 200 miles total were paved, the remainder being of macadam, except one instance—Bold Street) Mr. Dawson remarks, "There is no doubt but that granite is the cheapest as well as by far the most durable kind of pavement. It is also very noisy and has defects in resistance to traction, and accelerates the wear and tear of vehicles." I would interpolate that by better workmanship, diagonal courses, asphalte grouting, and more especially the introduction of stone trams, this can be reduced to a minimum.

Any elasticity required combined with quietness can be arranged for in the wheels. Light vehicles can be fitted with india-rubber tyres, but so far it has not been possible to use this in present forms for heavy vehicles, although tried a few months since at Glasgow upon omnibuses. Such a wheel might be looked for in compressed paper, over a steel framing and steel tyre all arranged as a solid circle. In London a Society was formed (whose members are chiefly horse-owners, carriage people, and carriers), with the title of the Horse Accident Prevention Society, and has been largely instrumental in inducing Vestries to adopt wood pavements, to the detriment in health, and depletion of the pockets, of ratepayers in the supposed interest of the horses; while undoubtedly they themselves chiefly benefit in reduced blacksmiths and coach repairing outlays.

As to injuries to horses by falling, I believe if shod rationally with uncut frog and light edges of steel on the Charlier system, and if one uniform material were adopted for roads in large cities, horses would be as firm footed as man himself, even on asphalte. But farriers and people connected with horses are more difficult to move in technical arts than any other condition of men.

Granite can be used as such a uniform material for all varieties of traffic, the depth and bulk of the setts varied to suit heavy or light work—of its admitted economy it is unnecessary to speak here.

My experience is that wood pavement cannot be, or at all events is not ever, kept clean, unless for a short period after first being laid. Anyone who walked up Upper St. Martin's Lane, Seven Dials, this afternoon need have no other evidence of this. The whole of the carriage-way was coated nearly three-sixteenths of an inch to a quarter of an inch with moist or dry horse dung, and its dust was scattered over the entire pavement and into shop doors, and I saw with regret the length of road opposite Aldridge's being laid with wood after standing as a protest, rough as it was, against the adjoining two materials for so long.

When London owns the water-works so that hose and jet can be used freely by night gangs for washing the surface of road and footway, and no objection is made by the custodians of the sewers to filth being washed into them, it may be possible to keep wood cleaner, but at enormous cost for labour, danger to horses, splashing of pedestrians, and rapid rotting of the wood.

Such a prospect offers little inducement to perpetuate wood in London at an excess cost over granite of some £130,000 a year for maintenance, which, if all its streets came to be so treated, would mount up to something like three-quarters of a million sterling *waste* per annum.

Though a wheel-tax may be unpopular as an imposition, it would be quite reasonable to insist on the adoption of a silent wheel for all future vehicles directly a suitable invention for heavy vehicles is evolved. The sooner the better for the community.

METEOROLOGICAL INSTRUMENTS AND SANITARY WORK.

By G. J. SYMONS, F.R.S.

The first of a series of six lectures on Meteorology in relation to Hygiene, delivered April 23rd, 1894.

It may be as well before commencing my lecture to explain that this series of lectures has been arranged by the Royal Meteorological Society in conjunction with The Sanitary Institute, both bodies cordially co-operating in the task.

Many of the instruments which I have to describe will be referred to later on by specialists, who, better than I can hope to do, will explain their bearings in detail. Any omissions or defects on my part will thus be remedied, or made up for, in the lectures which will follow.

For some inscrutable reason the barometer is almost invariably accorded the first place in meteorological observations, although from a sanitary point of view atmospheric pressure is perhaps the factor of least importance. I am not a medical man, but it seems to me that the trifling variations in atmospheric pressure which are observed at any given level cannot have much bearing on public health. This is a subject which will be dealt with fully in a subsequent lecture by Dr. Theodore Williams, so I need say no more respecting it.

The barometer is an instrument for measuring atmospheric pressure. It consists of a column of mercury, in a glass tube which plunges below into a receptacle also containing mercury. When the atmospheric pressure increases, the column of mercury mounts towards the top of the sealed tube, and when it decreases the column of mercury falls. The instrument is graduated (in inches and fractions of inches) from the level of the mercury in the receptacle below. It is evident, however, that the level of the mercury in the receptacle varies according to the height of the column, because the descent of the mercury in the column sends more mercury into the lower vessel, the level of which consequently rises, and *vice versâ*. The measurement would thus be rendered erroneous, and it is necessary to devise a means of obviating this disturbing influence. In Fortin's instrument the difficulty is got over by providing a leather bottom to the receptacle, which is governed by a screw, by means of which we are enabled to alter the level of the mercury. What we do is, as occasion requires, to raise or to depress the level until the surface of the mercury just touches the ivory indicator, which is the point from which the scale of inches starts. Another way to make allowance for this alteration of level, and its effect on the height of the column of mercury, is by substituting an empirical measurement for the real inch scale. That is the principle of the Kew standard. Each plan has its advantages and its drawbacks. Fortin's instrument, in the hand of a careful and experienced observer, gives perfectly reliable results; but if proper care be not taken to see that the level of the mercury just touches the ivory point, an error will creep into the records. If the cistern of a Kew pattern barometer leaks, it may be months before the error is detected.

Every barometer is provided with a thermometer, in order that the temperature of the instrument may be recorded at the same time as the height of the column. This is necessary, because the volume of the mercury varies with the temperature. Mercury expands with heat, and its specific gravity becomes less. This means of course that mercury at a high temperature takes up more room than the same mercury at a lower temperature. This then would be another source of error in barometric readings, but it is removed by reducing all barometric readings to a given temperature (32° F.). The calculation is easily made, and all Instructions for meteorological observations contain the necessary tables. Barometers are generally mounted in brass framework; but brass also expands with heat. The thirty inches of brass is more than thirty inches at a temperature of 80° F. The rate of expansion of brass being well known, the correction for it is combined with that for the expansion of the mercury in the tables above referred to.

Another correction necessary for meteorological work is to reduce the readings to what they would be at sea level. This, however, is not indispensable from a sanitary point of view. The difference between the sea-level pressure and that on the top of Hampstead amounts to something like half an inch, but for sanitary purposes that does not much matter. It is an unnecessary complication for our purpose, and may be dispensed with. Buxton, for example, is 1,000 feet above sea-level, but what we want to know is, not what would be the pressure at the bottom of a well there 1,000 feet deep, but how the Buxton people live and move under the pressure existing in their town.

There is an ingenious little device for taking very accurate readings of the barometer, which I must try to explain. It is called the Vernier, and although exceedingly simple in construction, it is far less simple to explain.

The scale on the barometer is usually divided into inches, tenths, and half-tenths (0·05); and the vernier, being made equal in length to 24 divisions of the scale, is divided into 25 equal parts. Each division of the vernier is therefore shorter than each division of the scale by the 25th part of ·05, which is ·002 in. To use it, first read off the division on the scale at, or below, which the lower edge of the vernier stands. Suppose it to be between 29·75 ins. and 29·80 ins.. the reading is 29·75 ins. *plus* the vernier indication. Next look along the vernier until one of its lines is found to agree with a line on the scale. Suppose this is at the second division above the figure 2 on the vernier; as each of the figures marked on the vernier counts as a hundredth, and each intermediate division as two thousandths, the reading of the vernier will be ·024 in. The reading of the barometer is therefore 29·75 + ·024 = 29·774 ins.

Before leaving the subject of barometers I must mention the Aneroid barometers. I look upon these as essentially travellers' instruments, but they must not be passed over altogether. They are very useful, and as now manufactured are fairly trustworthy. There is one form which is made to yield a continuous record, the only attention required being to put on a sheet of paper once a week and to wind up a clock. It is now possible to obtain a good recording aneroid barometer for one-fifteenth of what the old recording barometer used to cost.

We will now pass on to discuss the thermometer. Of this instrument there are several forms adapted to different requirements. There is one point which is not perhaps so generally known as it should be, viz., that they change with age. When the mercury has been put into the tube, sealed up, and the instrument graduated, the thermometer after a time, in the course of a year or so, may give a reading nearly a degree too high. Whether this is due to contraction of the glass, or to a molecular disturbance in the mercury, I cannot say, but the fact remains that there is at first a rapid, and then a more gradual, change in the direction of a higher reading. In the first instance this source of error was sought to be overcome by putting the thermometer (after filling and sealing) into a drawer for three years, by which time it was expected that the change in question would have taken place, and the divisions might then safely be placed upon the tube. But one could never be sure whether or not the tube had been left in the drawer for the requisite term of years, and therefore one could never be sure of the accuracy of the readings. The general result was that the old thermometers usually read too high. Some years since the late Mr. Denton devised a plan of avoiding this error, and his device—a very simple and ingenious one—was remarkably successful. He plunged the filled tubes into a bath of boiling oil, where he kept them for a week, by which time this contraction of the glass or molecular change in the mercury, whichever it was, had taken place. Denton was the first manufacturer to give us a thermometer with an invariable zero, *i.e.*, a thermometer which did not change with age.

A real standard thermometer is an expensive luxury; a luxury because it is not absolutely necessary for meteorological observations (for it is rarely necessary to have the whole range from 32° right up to boiling point). You can send a thermometer, comprising such part of the scale as you may require, to Kew, where they have a very admirable system of verifying thermometers. We can thus obtain thermometers correct to within a tenth of a degree, which is enough for all practical purposes. This verification is particularly necessary for clinical thermometers, that is to say, the thermometers made use of by medical men in taking the temperature of their patients. Given the facilities for verifying thermometers which the Kew authorities have provided, there is no excuse for any medical man's using a thermometer which has not thus been verified. The scale ought always to be marked on the tube itself, and I would recommend you to refuse any thermometer of which the scale is marked on the frame only. It is obvious that any shifting of the tube either way will at once falsify the readings, and for this reason thermometers not marked on the tube are unreliable.

The next modification of the thermometer is what is known as the wet and dry bulb thermometer. This comprises two thermometers arranged vertically, one of which is an ordinary thermometer, while the other has the bulb covered with a piece of gauze or muslin, whence a few strands of cotton lead to water in a copper receptacle. The water is by capillary attraction drawn up to the bulb, where it evaporates and the difference in the temperature of the wet and of the dry bulb gives the measure of the evaporating capacity of the atmosphere; the greater the evaporation, the lower the temperature of the wet bulb and the greater the difference between the two readings.

There are several forms of maximum and minimum thermometers, that is to say, thermometers designed to indicate the maximum or minimum readings during a given period of time. In the maximum thermometer designed by Professor Phillips, the thread of mercury is broken by a bleb of air, this bleb being equal to about one degree, and it is comprised in the measurement. When the mercury expands it presses on the bleb of air, and this in its turn presses on the detached portion of mercury, the extremity of which farthest from the bulb marks the maximum temperature. With a fall of temperature the mercury recedes only in that portion of the tube below the bleb of air, leaving the separated portion of the column at the point to which it has been pushed. We are thus enabled to see what has been the highest temperature to which this particular thermometer has been exposed. Of course it is necessary to set the thermometer each time, and this is done by lowering the bulb end when the detached portion descends to its original position, separated from the remainder of the column only by the bleb of air. Sometimes it is necessary to use more force to get the detached portion of the mercury down, and if too forcible a swing be given it, sometimes it happens that the bleb of air is displaced and the two portions of mercury coalesce. This renders the instrument useless as a maximum thermometer, for though it is possible to re-form the interruption in the column of mercury, it takes a skilled hand. Another pattern devised by Negretti and Zambra as long ago as 1852, is very ingenious. The tube is necessarily somewhat larger—a disadvantage, in that it of course renders the instrument less sensitive. The tube must be larger, because after the bulb has been blown and before the mercury is put in, the maker has to slip in from the top end a very fine thread of glass. This is allowed to slip down to where the bend is intended to be, and when it is there, the workman with a blow-pipe flame softens the glass and thereby fixes the glass fibre in the bend, thus making a sort of trap door at the angle. The mercury in expanding, forces its way upwards; but when the temperature decreases there is not force to oblige the mercury to pass the obstruction, and the upper part of the mercury remains to register the highest temperature reached. In order to set this instrument, you incline the bulb downwards, and according to the amount of obstruction, it either goes down readily or the resistance has to be overcome by shaking. There is the further drawback to this instrument, that owing to the obstruction offered by the trap door to the passage of the mercury, this is apt to rise by jerks, that is to say, if the temperature mounts say half a degree, the column may mount three, four, or six tenths. It follows then that the reading may be slightly in error. The merit of the instrument is that when once made and divided, it is almost impossible for it to get out of order.

A mercurial minimum thermometer is a great desideratum;

but the only good one, Casella's, is very difficult to make and very costly. We have therefore to continue to use the Rutherford. The bulb is filled with spirits of wine or some coloured liquid. The tube is very large and contains a little index. The end of the column of liquid, owing to the attraction which exists between liquids and glass, is drawn into a cup-shaped depression with its convexity directed towards the bulb, and consequently towards the little index which I have just mentioned. As the column of liquid descends, the convexity of the depression comes into contact with the end of the index, which also presents a convex surface, and it is pushed back to the lowest point reached, and there it remains; for when the temperature again rises there is nothing to move it. The end of the index farthest from the bulb therefore marks the lowest point reached. These minimum instruments have one inconvenience:—the spirit in them often evaporates towards the upper end of the tube, where it condenses. In well made thermometers we can see the whole of the tube and so are enabled to become aware of the evaporation and condensation. For this reason never accept an instrument in which the *whole* of the tube is not visible. It is evident that the spirit which condenses at the upper end has been removed from the main column of fluid, and that the reading is correspondingly falsified. It is worthy of notice that when a coloured fluid is used, the portion which evaporates and condenses at the other end does not always carry the colouring matter with it, and therefore observers may overlook the fact that evaporation and condensation have taken place. A little care, however, will prevent this oversight. To remedy this error, shake the thermometer several times with the bulb downwards, and stand it bulb downwards to drain for an hour, when the condensed spirit will have rejoined the column; then tilt the instrument gently till the index slides down to the end of the column. This having been done, the instrument is again ready for use.

Now as to the placing of the thermometers. The great thing is to secure them against their too immediate surroundings, and with this object in view, we employ what is called a Stevenson's screen. This is a box of which the sides are like venetian blinds or louvres. These louvres are double, the outer layers being directed from below upwards, and the inner layers from above downwards. The object of this arrangement is to keep the thermometers dry. When it is raining and blowing strongly, there is a danger that the row of drops which forms along the outer louvres might be blown in on to the thermometers, but with the double arrangement, and a gap between the two, this is almost impossible, and thus the errors which would result from the wetting of the thermometers are avoided. The box opens by a door, and it is an advantage that this door should point towards the north, because then, during the time of taking the readings, the sunshine will never fall on the thermometers. The top of the box is double in order to preserve the instruments as much as possible from the direct influence of the sun's rays. In this respect we are only partially successful, for the temperature is not quite the same in all parts of the box.

Formerly the Glaisher or Greenwich screen was much used. It is fixed on a post and is made to revolve so that the part carrying the thermometers is never exposed to the sun. The disadvantages are that it has to be turned several times a day to keep the thermometers away from the sunshine, and that if the rain comes from the direction opposite to that in which the sun is, the thermometers are bound to get wet.

The situation for an ideal meteorological station is the centre of a large lawn, nearly level, and with no lofty trees within at least 200 feet, and no building within 100 or 150 feet. In this the instruments should be so placed that no one prejudicially affects the indications of any other, and all should be enclosed by a very light and unclimbable iron fence.

A rain gauge consists of a receiving aperture which leads to a funnel whence the rain passes into a bottle. All that has to be done is to remove the upper part of the apparatus and pour the water from the bottle into the graduated measure, and record the result. In order to fix the gauge and keep it steady, posts are driven into the ground, the mouth of the gauge being left about a foot above the ground.

We now come to instruments not indispensable for ordinary meteorological observations. The apparatus for determining the temperature of sunshine—solar radiation—consists of two thermometers, in one of which the bulb is left bright, and in the other the bulb is coated with lampblack. Each bulb is enclosed in a thin glass sphere, from which nearly all the air has been exhausted, in order as far as possible to insulate the bulbs from neighbouring objects, and especially from wind. These spheres, and the partial vacuum within them, render the thermometers nearly independent of the cooling influence of wind, &c. If a looking-glass is placed in the bright sun the rays of light and heat are nearly all reflected, the mirror remains quite cool. This is the case with the unpainted bulb, while the blackened bulb absorbs all the rays, and marks a correspondingly higher temperature. The difference may amount in this country to forty-five, or even fifty degrees.

For ascertaining the temperature of the soil it is usual to employ an iron tube (watertight at the bottom), which is driven into the ground to the required depth. Inside it, hangs a thermometer, the bulb of which is protected by some non-conducting substance, so that no alteration may take place while it is being drawn up for the purpose of being read.

A thermometer well protected against breakage and against rapid change of indication should, where practicable, be used for determining the temperature of the sea; but this should be from a boat or a pier head as the water close in shore is warmed by washing over the warm sand.

The next apparatus is the old cup arrangement for measuring the velocity of wind. It consists of four cups at the end of short arms placed horizontally on a vertical spindle or shaft, in consequence of the pressure on the concave surfaces of the cups being greater than on their convex ones, they revolve with the wind and cause the wheels connected with the spindle to go round, and record the number of revolutions on a dial. This is a somewhat primitive apparatus, which has probably seen its best days. Mr. Dines's tube anemometer will, I think, supersede it.

Before leaving the subject of Instruments, it will probably be well to add a few words respecting—(1) which are essential and which are desirable, (2) their purchase, (3) their verification, (4) their erection, (5) their observation.

(1) For climatological work the following outfit is esssential:

α = Stevenson's thermometer screen—and it must be kept clean and frequently repainted white.
β = Dry and Wet bulb thermometer divided on the stems.
γ = Max. and Min. thermometers " " "
δ = A rain gauge—preferable a Snowdon pattern one.

Desirable additions are:

A = Standard barometer, Fortin's or Kew pattern.
B = Earth thermometers, one for 1 foot deep and one for 4 feet deep.
C = Sunshine recorder—preferably Campbell-Stokes' pattern.
D = Black and Bright bulb vacuum thermometers for temperature in Sun.

(2) As regards the purchase it would ill become me to recommend any one firm, seeing that most of the instruments can be bought of several makers of equal quality and at similiar prices, but I should neglect my duty if I did not indicate that for instruments worth recording it is necessary to pay a good price—low priced instruments are never worth either buying or observing.

(3) Do not accept a maker's certificate, insist upon having Kew certificates, for which on the average you will have to pay about 2s. 6d. each.

(4) and (5) obtain a copy of "Hints to Observers," prepared by the Royal Meteorological Society.* It is practically an infallible guide, far better than anything that I could say here, and so well worth the money that I feel no hesitation in recommending it to your notice.

I may add that the accessibility and lowness of price of the above mentioned "Hints" have led me throughout this lecture to render my remarks as far as possible supplementary to it, instead of repeating the descriptions and engravings which are to be found there.

Assuming that the instruments have been duly obtained, and placed in position, we have still to deal with the utilization of their indications. Firstly, there is the mode of reading, and of setting, and the time of making the observations (always 9 a.m., and preferably 9 a.m. and 9 p.m.), but all these points are dealt with in "Hints," so I pass to the selection of data for publication and to the representation of the results in diagrams.

The importance and advantage of representing statistical data by curves can hardly be overrated, and this is as fully illustrated by the representation of climatic and disease data as by any other group of correlated facts, whether it be wind velocity and the number of shipwrecks, climate and the price of flour, May frosts and the yield of fruit, or anything else.

I append (page 168) a very simple diagram merely to give suggestions as to modes of plotting. Those who wish to see the most nearly perfect diagram illustrative of health, mortality and climate known to me, should try to get a copy of that issued for Nottingham by the Medical Officer of Health (Dr. Boobbyer), and by the Borough Engineer (Mr. A. Brown, M.Inst.C.E.)

I proceed now to explain the diagram which graphically represents the figures in columns 5, 2, 7, 8, and 11, of the table on page 168.

Each vertical line represents midnight, *e.g.*, the first thick line represents midnight between February 28th, 11 p.m., and March 1st, 1 a.m., therefore each column represents the civil day of 24 hours of the date mentioned at the top. Suppose that it was desired to enter two readings daily of the barometer, say at 9 a.m. and 9 p.m., the former should be entered rather short of the middle of the column, and the latter rather short of the midnight line.

As regards the wind which is entered in the top squares (rarely wanted for anything else), the arrows fly with the wind, the first indicating S.W., the next W., and so on. If the direction of the wind is recorded twice daily the second observation can be entered in the next lower line of squares.

---

* Published by E. Stanford, Cockspur Street. 1s.

In the specimen, I have avoided the use of colour, but blue and red pencils add much to the clearness of the diagram. As a general rule red should be used for heat, *e.g.*, for daily maxima, and blue for cold, *e.g.*, for the minima, and for rain. But colours may be reserved for indicating diseases, as is done on the Nottingham diagram.

The figures in column 2 are represented by the thick continuous curve. The barometer scale will be seen on the left hand, and the first entry, 29·942, should obviously be rather less than half way between the lines representing 29·9 and 30·0; a dot is made at this point, and in the position near the middle of the column representing the time of reading, viz., 9 a.m. On March 2nd the pressure was 30·065 in., or rather more than half way between 30·0 and 30·1; a dot is made as before, and a line joining it to the dot for March 1 starts the curve which goes on *de die in diem.*

Similarly for temperature, of which the scale is on the other side of the diagram; but here it will be seen that each space represents 3°, this is in order that all air temperatures usual in this country may be provided for. The maximum on the first is 48°·8, evidently slightly more than half way between the lines for 47° and 50°; dots are made as for the barometer, and they are joined either by a flowing curve as in the early part of the diagram, or by a stepped one as in the later part.

The minima are entered in precisely the same way.

The intervening space represents a very important element in climate; its variability, or, as it is properly called, the amount of diurnal range, *i.e.*, the difference between the min. and the max. on each day. This space can be blacked in, shaded or left clear as preferred.

Lastly, the rain is represented by vertical columns, in accordance with the rain scale given at the side.

The sanitarian is constantly needing the help of the meteorologist, whether it be for water supply, town drainage, or sewage disposal; or for minor matters, such as ventilation, the humidity of the air in factories, &c.; but in the present course we have rather to consider individual health, and I do not know that I can more usefully conclude this lecture than by referring you to a few works which deal with the subject.

Ackerman, H. Das Wetter und die Krankheiten. 8vo. Kiel, 1854.

Ballard, E. A Study of the Influence of Weather and Season upon Public Health, made upon above 217,000 cases of sickness newly occurring at various institutions for the relief of the sick poor in Islington, during the nine years 1857—65. Med. Chir. Tr. London, 1866—67.

——— Also various papers in the Report of the Medical Officer of the Local Government Board.

Balley, F. Météorologie et météorographie pathogénie et nosographie; ou

éléments de recherches sur la connexion entre les divers agents météorologiques et la pathogénie civile et militaire à Rome (de 1850 à 1861). 4to. Paris, 1863.

Baxendell, J. On the Influence of Changes in the character of the Seasons upon the rate of mortality. Mem. Lit. & Phil. Soc. Manchester. 1871.

Bert, P. La Pression Barométrique; recherches de physiologie expérimentale. 8vo. Paris, 1878.

Blane, G. Narrative of a Hurricane; with some reflections on the effect of commotion in the atmosphere and in the ocean, on the economy of nature, and on life and health. In his "Select Dissertations." 8vo. Lond., 1822.

Buchan, A., and Mitchell, A. The Influence of Weather on Mortality, from different diseases and at different ages. Jour. Scot. Meteor. Soc. Edinburgh and London, 1874—5.

Buchanan, Sir G. "On the relation of Phthisis to Soil Moisture;" and other papers in the Report of the Medical Officer of the Local Government Board.

Foissac, P. De la Météorologie dans ses rapports avec la science de l'homme et principalement avec la médicine et l'hygiène publique. 2 vols. 8vo. Paris, 1854.

Forry, S. Statistical Researches relative to the Etiology of Pulmonary and Rheumatic diseases, illustrating the application of the laws of climate to the science of medicine, based on the records of the Medical Department and Adjutant-General's Office. Am. Jour. Med. Sc. Philadelphia, 1841.

—— The Climate of the United States, and its Endemic Influences. New York, 1842.

Forster, T. Observations on the Casual and Periodical influence of particular states of the atmosphere on human health and diseases, particularly insanity. With a Table of reference to authors. 8vo. London, 1817.

Guillié, E. Rapports des Maladies avec l'atmosphère. Essai sur l'application de la méthode graphique à leur étude. 4to. Paris, 1871.

Guinier, H. Du degré d'importance des études météorologiques pour la connaissance et le traitment des maladies. 4to. Montpellier, 1857.

Hallmann, E. Die Temperaturverhältnisse der Quellen. 2 vols. 8vo. Berlin, 1854—5.

Hunt, S. B. Report of the Committee on the Hygrometrical state of the atmosphere in various localities, and its influence on health. 8vo. Philadelphia, 1855.

Huxham, J. Observations on the Air and Epidemical Diseases, made at Plymouth, from the year 1728 to the end of the year 1748. To which is added a short Treatise on the Devonshire Colick. Transl. from the Latin. 2 vols. 8vo. London, 1758—1767.

Liebig, G. von. Ueber die Einflüsse der Temperatur und Feuchtigkeit auf die Gesundheit. Berlin klin. Wochenschr, 1870.

Meteorology in Relation to Health. Conferences by the Royal Meteorological Society. 8vo. London, 1884.

Moore, J. W. Notes on Mean Temperature in its Relations to Disease and Mortality, with special reference to the City of Dublin. Dublin Q. J. M. Sc. 1869.

—— Meteorology in its bearing upon Health and Disease. Jour. Roy. Dublin Soc., 1873.

Pope, J. H. Climatology and Epidemics. Tr. Texas Med. Ass. Columbus, 1875.

Smith, R. A. Air and Rain. The beginnings of a Chemical Climatology. 8vo. London, 1872.

Tripe, J. W. An Inaugural Address on Some of the Relations of Meteorological Phenomena to Man. Delivered before the Society of Medical Officers of Health, October, 1882. 8vo. London. 1882.

Vigouroux, P. De l'influence Météorologique sur les manifestations rhumatismale pendant l'hiver 1875. 4to. Montpellier, 1875.

Williams, C. Theodore. Aero-therapeutics, or the treatment of lung disease by climate. 8vo. London, 1894.

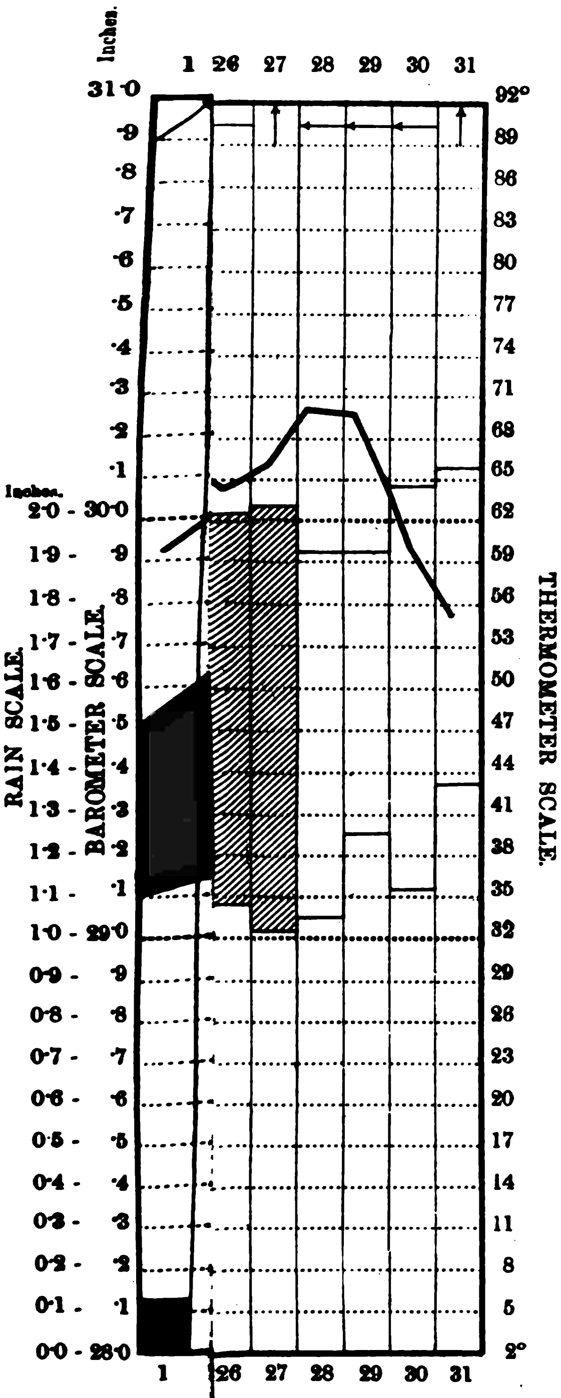
METEOROLOGICAL OBSERVATIONS.

CAMDEN SQUARE, LONDON.

Lat. 51° 32′ 40″ N; Lon. 0° 8′ 0″ W; Altitude 111 feet.

Date.	9 A.M.					In the Day.				
1894. March	Barometer at 32° and Sea Level.	Hygrometer.		Direction of Wind.	Temperature of Soil at 1 foot.	Shade Temperature.		Radiation Temperature.		Rain.
		Dry.	Wet.			Max.	Min.	In Sun.	On Grass.	
	Inches.	Deg.	Deg.		Deg.	Deg.	Deg.	Deg.	Deg.	Inches.
1	29·942	47·1	43·7	S.W.	40·1	48·8	35·2	68·0	28·8	·124
2	30·065	40·1	38·1	W.	40·6	51·8	36·3	93·1	29·0	...
3	30·238	33·8	32·3	N.	39·9	50·0	28·6	80·1	22·2	...
4	30·065	38·1	37·6	N.W.	39·6	50·9	32·9	87·2	28·0	...
5	30·366	36·4	34·2	W.	39·7	49·4	29·9	91·1	22·1	·121
6	29·659	46·9	42·1	W.	39·9	52·9	36·9	101·1	31·1	...
7	29·894	40·2	37·8	N.	40·2	48·8	34·3	78·2	26·7	·020
8	29·650	47·4	45·9	S.W.	40·8	48·7	40·2	53·1	36·1	·151
9	29·651	46·3	44·3	S.W.	41·0	50·8	38·1	69·0	29·4	·084
10	29·685	46·6	43·4	W.	41·9	54·7	43·1	84·4	36·7	...
11	29·517	49·8	47·9	S.W.	42·8	55·2	45·6	89·8	38·3	·022
12	29·697	43·9	40·1	S.W.	42·2	52·0	38·6	86·9	32·1	·250
13	29·211	42·1	38·6	W.	42·4	50·9	41·2	94·9	39·9	·012
14	29·559	41·2	38·3	W.	42·2	50·9	34·1	92·0	29·2	·402
15	29·411	41·8	40·2	N.E.	42·1	50·1	39·3	96·4	36·6	...
16	29·847	39·4	36·8	N.	41·9	50·7	29·2	92·3	23·0	...
17	30·227	35·4	35·2	N.	40·9	49·4	30·9	91·6	23·3	...
18	30·334	38·2	36·2	S.W.	40·7	50·2	30·6	76·9	23·2	...
19	30·336	35·2	35·1	N.	39·7	55·1	29·3	91·6	22·6	...
20	30·303	48·4	46·9	N.	40·9	54·2	36·1	76·1	31·9	...
21	30·272	45·8	42·9	E.	41·9	57·1	39·7	97·6	28·8	...
22	30·389	43·1	41·9	N.E.	42·5	48·8	38·9	64·1	31·7	...
23	30·500	40·8	40·6	N.E.	42·4	56·4	37·2	93·0	29·6	...
24	30·399	40·6	40·4	Calm	42·8	58·6	35·5	97·1	28·4	...
25	30·200	47·9	44·6	N.E.	42·8	59·4	37·0	94·6	31·2	...
26	30·074	46·6	43·2	E.	42·9	62·6	34·6	102·8	25·8	...
27	30·126	46·6	42·7	S.	42·9	63·2	32·1	92·2	24·3	...
28	30·279	41·1	39·5	E.	42·9	59·3	33·2	95·1	24·2	...
29	30·268	41·2	40·9	E.	43·7	59·4	39·7	88·9	36·6	...
30	29·951	48·0	44·9	E.	43·9	64·8	35·3	100·4	28·4	...
31	29·771	55·2	48·0	S.	44·6	65·8	43·4	108·8	34·0	...
Mean	29·996	43·1	40·8	...	41·7	54·2	36·0	88·0	29·5	1·186
1	2	3	4	5	6	7	8	9	10	11

WIND.



S, *Observer.*

TEMPERATURE OF SOIL, WATER AND AIR.

BY HUGH ROBERT MILL, D.Sc., F.R.S.E.

Second of a series of six lectures on Meteorology in relation to Hygiene, delivered 26th April, 1894.

THE study of warmth and its distribution occupies comparatively little of the attention of meteorologists, and it seems a paradox to say that the effects of heat on the air account for all the phenomena of meteorology; but the paradox vanishes when we recollect that warmth is only one of the minor results of the action of heat. The essential difference between heat and temperature must be clearly understood and continuously remembered. Heat is a real thing, one form of the power of doing work which is known as energy; temperature is only a state of bodies regarding heat. Temperature of two contiguous bodies is the same when there is no tendency for heat to pass between them in one direction rather than the other; heat always passes from the body at higher temperature to that at lower temperature. When heat passes from any substance at a higher temperature to our body we call the sensation so produced warmth, but when heat passes from our body to any substance at a lower temperature we term the sensation coldness, and these sensations admit of degrees of comparison. Again it must be remembered that substances at the same temperature do not necessarily contain the same amount of heat, just as vessels in which water stands at the same level do not necessarily contain the same quantity of water. A pound of water for example requires thirty times as much heat as a pound of mercury in order to raise its temperature through the same number of degrees, in other words water has a greater capacity for heat than mercury, or indeed any other substance. If the capacity for heat of water is called one, that of most rocks would be one-fourth and of air about one-fifth. When heat is transformed into work or into any other form of energy it cannot at the same time produce a change of temperature, the law as to eating a cake and having it is a fundamental law of nature. In order to understand the effect of heat on the complicated structure of the Earth's surface, we must consider its effects on solid, liquid and gaseous bodies, and in particular its action on the actual substances of the solid land, the oceans and the air.

In solids, heat is propagated by conduction or direct passing-on from particle to particle, while across intervening space it is propagated by means of a vibratory movement in the ether which permeates all space. This process is known as radiation. The speed of radiation is constant, it is the speed of light, for radiant heat and light differ only in degree; but the rate of conduction varies with each substance, being greatest for metals such as silver, copper and mercury, least for water and air or for such solids as wood or cork. When radiant heat falls on a solid surface it is partly reflected and partly absorbed, the proportion suffering each change depending on the angle of incidence of the light, on the colour and physical state of the surface and not on its conductivity. Reflected heat produces no effect in the solid, but the fraction which is absorbed raises the temperature provided the solid is not melting. In good conductors the rise of temperature is passed on throughout the mass comparatively quickly; in bad conductors it is practically confined to the absorbing surface. Thus a bad conducting surface like sand becomes much hotter in the sun than a good conducting surface like basalt. The elevation of temperature in any one kind of substance is always the same for the same addition of heat, and it is accompanied by expansion of the substance, as a rule proportional to the rise of temperature. Bodies which readily absorb radiant heat part with it again when the temperature of surrounding objects is lower than their own with equal ease. "Light come, light go" is a physical axiom; the quick absorber is a quick radiator, the slow absorber is a slow radiator. Similarly with regard to capacity for heat, the substance which requires to receive a great amount of heat to warm it by 1° requires to part with the same amount of heat in cooling by 1°, so the easily heated quickly cools, and that which can only be heated slowly retains its heat long. In regard to conductivity also the same axiom holds good. Some solids in thin slices allow radiant heat to pass through them without being altogether absorbed, rock-salt is an instance. If radiant heat were to enter an immensely thick block of rock-salt it would travel to a great depth before being completely absorbed, and thus the mass would have its temperature raised throughout and not on the receiving surface only as in the case of most bad conductors. Usually only some special heat rays are absorbed and the others pass through.

In liquids we find that all these conditions hold good, just as in solids. Liquids differ amongst themselves in capacity for heat, in diathermancy (both of which are usually greater than in solids), in absorbing and radiating power, and in conductivity (usually less than in solids), but all liquids when absorbing heat (and not evaporating) rise regularly in temperature, and expand more or less uniformly in volume. If heat is applied to a liquid from below, the individual layers or particles which are heated and expanded rise through the cooler and denser portions, and so carry heat throughout the mass by convection. If heated from above, a mass of liquid at rest rises in temperature on the surface, and the upper layer has no tendency to sink, so that heat must be passed down by the slow process of conduction. Most badly conducting liquids, however, are diathermanous, and may thus be heated by radiation to a considerable depth. On the other hand, if cooling by radiation upwards, the top layer, shrinking as its temperature falls, will sink and allow the warmer layers below to come to the surface. Thus, a mass of still water exposed only above, cools by convection, whilst it must heat up by conduction, if the liquid be not the solution of a salt, which becomes concentrated by evaporation, as in the case of enclosed tropical seas.

Gases share all the properties already enumerated with the denser states of matter. If not undergoing any chemical change any single gas, or mixture of gases, far from their liquefying temperature, receives or parts with heat by absorption or radiation, allows heat to pass through its mass by conduction or convection; but all gases are very diathermanous, allowing a far greater proportion of heat to pass through unabsorbed than liquids or solids do. A gas is heated most readily by contact with solids or liquids at a higher temperature, convection ensuring rapid equalisation of temperature; and as its temperature rises the gas expands with great regularity. Unlike liquids and solids, each kind of which has its own rate of expansion; every gas expands by $\frac{1}{274}$th of its volume for each degree centigrade, or $\frac{1}{490}$th for 1° F., so that the diminution of density it experiences when heated under constant pressure may easily be calculated.

We must go a little deeper into physics in order to follow the thermal changes of gases. Every gas is made up of myriads of particles, probably molecules, all in rapid motion. The rate at which the particles move depends on the amount of kinetic energy in them, and, speaking generally, one might say that the rapidity of motion depends on the temperature. A rise of temperature causes more rapid movement, gives longer paths, and so produces expansion when the pressure remains the same; thus only a part of the heat is employed in raising the temperature, the rest is occupied in expanding the volume—doing work. If a certain quantity of a gas were suddenly expanded, the increased path of the molecules demands increased motive power, and this can only be supplied from the heat in the gas itself, and the temperature immediately falls. To put it generally: when air is expanded it is chilled, and if no source of outside heat is available, its temperature falls.

This fact is of vast commercial importance in the working of refrigerator machinery. Conversely, if air is compressed heat is liberated, and if the heat cannot radiate away at once its temperature rises. The path of the darting molecules is reduced, and consequently, as in the case of a brake on a railway train, heat is generated.

There are other important thermal relations, which must not be neglected. While the effect of heat on solids, liquids and gases is always to raise temperature and cause expansion, there are pauses in the process while physical change of state is occurring. For the meteorologist these phenomena are of interest only with regard to one overpoweringly important substance—water. It is practically the only naturally occurring substance which is always present on the Earth in its three physical states. In the polar regions it is a rock, elsewhere it forms the oceans and rivers, and everywhere it is an essential constituent of the atmosphere in the form of vapour.

Cold ice is a rock and nothing else; it happens to be less dense, more brittle and more fusible than other rocks, but that is all. When heat is applied it expands, and the temperature rises at the rate of 2° for every unit,* rock-ice having just half the capacity for heat of water. But when a mass of ice is heated to 32° F. the farther addition of heat affects its temperature no more, and actually diminishes its volume, the heat is doing the work of changing rigid ice into mobile water. The amount of heat required to perfect this change is 144 units for each pound of ice. At the end there results one pound of water at 32°. The capacity for heat of water is twice that of ice, and each unit of heat added raises the temperature of one pound of water by 1° F. although the volume continues to diminish until 39° is reached (the maximum density point). Thereafter volume and temperature increase together until, under normal pressure, at 212° farther temperature change is stopped and all the heat is set to the work of turning water into steam. In this process 967 units of heat are required; and, when it is accomplished, the addition of heat raises the temperature of the pound of steam once more at the rate of about 2° for each heat-unit, as the capacity for heat of water-vapour is only half that of water. The process of condensation, on the other hand, sets free all the heat which was used up in evaporating, and the process of freezing sets free the heat which was used up in melting.

It happens that evaporation takes place to some extent at all temperatures, but we can state broadly that to produce a pound of water-vapour always requires the same amount of heat whatever the temperature at which it is formed. Thus evaporation from the surface of water lowers the temperature, because heat is withdrawn from circulation as temperature to be stored up in the vapour. Similarly whenever vapour condenses into snow or rain every unit of the stored-up heat has to be paid out. Here we see another immensely important agent for regulating changes of temperature in the air and conveying heat for great distances, a sort of complex convection. This greatly complicates the study of the effect of heat on atmospheric air. It must be remembered that the capacity for heat of air is, if the pressure remain constant, about one-quarter that of water so that the heat set free by the condensation of 1lb. of rain at 60° would suffice to raise the temperature of 450lbs. or 6,000 cubic feet of air from 60° to 70° if it were all absorbed.

---

* The unit employed in this lecture is the amount of heat required to raise the temperature of water, 1° F., from 32° to 33° F.

This brief summary of the physical condition of land, water, and air with respect to heat has been generalised and simplified to the last degree, and is no more like the actual occurrences in nature than a stiffly articulated skeleton is like a living being. Nevertheless it is the rigid frame round which the whole of the complex and as yet only partially understood science of meteorology is wrapped. It is presented in strictly popular language, and is consequently on the same level of accuracy as a summary of human anatomy in which it was forbidden to call the bones or muscles by their technical names.

The surface of the Earth is the meeting place of the atmosphere which lies all above it, and the solid and liquid masses of land and sea which lie all below it; but curiously enough this surface is the main region of heating for air and land and sea alike. Heat comes to it from within and from without. The internal heat of the Earth is, however, of little relative importance, the amount which is conducted upwards through the rocks in a whole year would probably not do more than melt an ice covering one-quarter of an inch thick, while the heat reaching the Earth from the moon and stars is almost incalculably small. There remains the Sun as the great source of heat—heat which is available not only for warming the Earth and air but for keeping up the whole majestic system of oceanic and atmospheric circulation, and in addition carving out the characteristic scenery of every land surface. It is calculated that the total solar heat received in a year would suffice to melt a shell of ice 100 feet thick entirely covering the Earth; and this amount is only one two-thousand-millionth of the total solar radiation.

The manner in which the Sun's heat is received and turned to account is a direct consequence of the relation between the axis of the Earth and the plane of the ecliptic, and of the diurnal and annual motions of our planet. The angle at which the heat-rays strike the surface affects the intensity of solar action, the same beam of solar radiation which when striking vertically covers one square foot of ground, would when falling at an angle of 30° cover two square feet, and consequently heat them only half as much. The durations of seasons and their theoretical intensity of contrast are mathematical functions of the Earth's form and motions, and if the air were always still and the whole surface were either uniform motionless sea or uniform land, the distribution of climate would be strictly according to latitude; then the old familiar divisions of frigid, temperate and torrid zones would hold good. All these "ifs" are foreign to the system of nature, where one agency is ever balanced against another, and cause and effect are continually interacting, The atmosphere alone makes the theoretical distribution impossible. By refraction we see the sun before it rises on our theoretical horizon and after it sets beneath it. Refraction practically shifts the polar circles four or five degrees poleward and shortens the theoretical half-year's polar night by a week or more. On the other hand the increased absorption of the heat-rays which pass obliquely through many extra miles of atmosphere reduces the heating power available at the surface in high latitudes. But the complete subversion of the mathematical conception of climate is brought about by the movements in air and sea set up by unequal heating and by evaporation.

We may conveniently begin by assuming the diathermancy (which involves the large assumption of the cloudlessness) of air and looking at the effect of solar radiation on the solid land. Part of the incident radiation—light as well as heat—is reflected and sent back through the air. White chalk cliffs and pale coloured soils reflect most, and are thus least heated, while dark soil or rock absorbs all radiation and rises rapidly in temperature during sunshine. Wet ground heats more slowly an account of evaporation, and a swampy or boggy surface acts rather like water than like land. The physical character of the soil has much influence on its warmth. Sand or loam of an open and porous texture heats rapidly on the surface, but the warmth does not penetrate on account of the non-conducting character of the air imprisoned between the grains, while a dense clay soil is a comparatively good conductor and transmits warmth to a considerable depth. Taken as a whole the solid surface of the Earth absorbs heat rapidly during sunshine and its temperature rises greatly. In the Sahara, for example, where the influence of the land reigns supreme, it is possible to cook eggs by covering them with the hot sand; and one of the few travellers who have explored this region was obliged to make wooden shoes for his faithful dog to save the animal's paws from being scorched. At night the change of temperature is rapid, radiation takes place freely to space, and the land loses its excess of heat so quickly that a thin crust of ice may form on exposed water almost under the tropic. The adjustment of various compensating arrangements, in which the absorbing power of atmospheric dust and vapour plays a chief part, seems at present to be such that on the average of a year the surface of the Earth loses just as much heat as it receives; but if the Earth were bare like the moon the radiation to space would in all probability spend more heat than the alternate radiation from the sun would be able to pay in, and our own planet, like its satellite, would become bankrupt in energy.

During summer the daily process of heating lasts longer than the intermittent process of nightly cooling and the soil stores warmth, laying by the daily surplus of receipts over expenditure. In autumn, income and expenditure balance, and when winter sets in every long night draws on the accumulated capital of summer until the fall of soil temperature is checked by the advent of spring. It has been calculated that $\frac{1}{30}$th of the sun's rays falling on bare ground are reflected, while $\frac{1}{6}$th of those falling on snow are turned back, in other ways land under snow is kept cold, at least kept down to 32°, and until the whole of the snow is entirely melted the land cannot grow warmer. Ground covered with vegetation is also slow in heating or cooling, much of the solar power being used up in evaporating moisture from the leaves and in carrying on the vital functions of the plant.

The depth beneath the surface to which the rhythmical rising and falling of temperature are carried depends on the range or difference between the highest and the lowest temperature and on the interval of time which separates them. The diurnal range diminishes rapidly until in this country it vanishes about 3 feet below the surface, but the greater and slower wave of annual change can be detected to a depth of 40 feet or so. These depths vary somewhat on account of variations in the character of the rock and the intensity of radiation at the surface. Three feet is perhaps the minimum depth at which metal water-pipes can be laid in this country to avoid all risk of freezing in any ordinary winter. In the Arctic Regions where the annual range of temperature is very great the soil remains permanently frozen to the depth of several hundred feet, the minimum temperature being readily conducted downwards while the maximum is stopped by melting the first few feet of ice. In other places the invariable layer unaffected by surface change occupies a definite position; the deep cellars of the Paris Observatory lie in it and their temperature never varies, while in the tropics it approaches to within a few feet of the surface. In all cases retardation of the date of maximum and minimum occurs as the depth increases and the range diminishes. Natural caverns, on the other hand, though deep are subject to considerable seasonal changes of temperature. At Edinburgh a set of thermometers embedded in a hole bored into solid rock showed at 2 feet a minimum temperature of 39°4 in February, and a maximum of 53°0 in July, with a range of 13°6 for the year; while at 20 feet the minimum of 45°4 was reached in July and the maximum 46°9 in January, the range being only 1°5, and the retardation of the maximum and minimum being six months after the surface. The changes of temperature on the surface of bare rock or soil are the simplest with which we have to deal, reflecting clearly the solar and terrestrial radiation which produce them.

The seasonal changes of temperature in water are more complex than those in the solid land, because the action of heat not only serves to change the temperature but to give rise to movements, and to cause evaporation as well. Speaking generally, water may be said to be less responsive than land to seasonal change, but in varying degree according to its surroundings.

Deep-seated springs rising from depths of the crust below the invariable layer are independent of surface changes altogether, and maintain a temperature corresponding to that of the rocks through which they have passed.

In rivers we find that the seasonal changes are similar to those of land, except that the annual and diurnal range are reduced. There is no theoretical minimum or maximum to land temperature within the meteorological range, but fresh water can never become colder than 32°, unless frozen solid to the bottom; thus the curve for river temperatures during the winter months in cold countries is a straight line. The daily march of temperature in a river depends partly on the strength of solar radiation, partly on the temperature of the air above, and partly on the temperature of the ground beneath. Solar heat falling on the surface is in part absorbed, but in large proportion passed on to the bottom, which when heated by absorption imparts its increased warmth to the water from below. Careful observations show that even in comparatively deep rivers the temperature changes uniformly throughout the whole depth, the water being thoroughly mixed in consequence of its onward flow. Muddy rivers have a greater range of temperature than those in which the water is clear, but in all cases the range of temperature in water is less than that in soil, the same amount of heat can only produce about one-third or one-quarter the rise of temperature; much heat is carried away by evaporation, and the whole mass is heated uniformly instead of the surface layers alone. The average diurnal range of river temperature in temperate countries is probably not greater than 3°, and even in the tropics the range is small. Temperate rivers are at their coldest about 8 a.m., and at their hottest about 4 p.m., these hours differing somewhat according to the time of year. The annual changes occur nearly in the same order as those of air temperature, except in the case of rivers fed by melting snow in summer, or subject to floods of cold rain.

The temperature changes in estuaries are too complicated to be referred to here, but they may be taken as transitional between the changes of rivers and those of the open sea.

Fresh water lakes have a peculiar and very interesting *régime*. If the water contained in a deep lake were absolutely at rest, it would heat up by conduction from the surface during summer, and when it came to a maximum in Autumn would be found with the highest temperature at the surface, the lowest temperature at the bottom, and between these the change would be rapid near the surface, becoming more gradual below. When cooling by night began to counterbalance heating by day, the surface temperature would rapidly fall, and the water becoming denser would sink, giving rise to rapid mixing, so that the whole mass of water would cool simultaneously, the shortening periods of sun-heating only sufficing to arrest the process at the surface for a few hours out of the twenty-four. As soon as the surface temperature, sinking by radiation, reached 39°, the process of cooling would be changed. Henceforth, water expands as it cools, and the mass of the lake would remain at 39°, cooling very slowly by conduction upward, while the upper layer by radiation, and contact with air cooled by the colder land would ultimately freeze. The process of heating which follows might not continue long enough to affect the deepest layers, and consequently the vast lakes of North America, and the deep lakes of Europe, have always a mass of water at 39°, filling the lower part of their basins. The annual range of the mean temperature of such lakes is slight, although at the surface the range is considerable, but retarded in its periods of maxima and minima as compared with the land.

We must now consider some of the disturbing causes which destroy the theoretical simplicity of the changes referred to above. It is often found in summer that at the surface, one end of a lake may be ten or twenty degrees warmer than the other, and I have repeatedly found in winter that a deep lake has become chilled far below the maximum density point throughout its whole depth. One cause of the first condition is the much greater heating power of radiation in shallow than in deep water. A thin layer of water allows the heat which passes through it to be absorbed by the ground, which in return speedily heats the water by contact, convection aiding the process. In deep water the sun's rays are gradually absorbed in a great mass of water and produce little effect at the surface. The second condition, and in part the first also, are to be explained, as Dr. Murray has clearly proved from our experiments, by the action of wind banking up the surface water at one end, and so producing an up-draught of cold water at the other end, to take its place. Wind producing vertical circulation of this sort may at any time of year thoroughly mix all the water of a lake, and reduce it to its average temperature. The general action of a lake is to heat up in summer more slowly, and to a less degree, than the land, and to cool down in winter more slowly and to a less degree.

When a lake basin is in more or less free communication with the sea and becomes filled with sea-water the temperature changes that it undergoes are extremely complex, and my principal work has been to investigate these conditions in the remarkable group of sea-lochs which form the Clyde Sea Area. It would take many hours to explain all the facts we have discovered in that region, but roughly they may be summarised thus:—The shallower and fresher a sea-loch is the more nearly does it correspond in its behaviour to a fresh-water lake, having a considerable range of temperature. The deeper a fjord is, and the more completely cut off from the sea, the lower is its mean annual temperature, and the greater the contrast between surface and bottom temperature. For one thing, the surface water in such mountain-girdled fjords is always much fresher and less dense than that below, and no amount of cooling would cause downward convection currents. Vertical mixture is only brought about in these cases by the occasional gales of wind which blow long enough in the right direction. The annual range of temperature at the surface in Loch Fyne is about 20°, at the bottom in 400 feet it is less than 2°, and the bottom water is warmest nearly six months after that at the surface, the water allowing the annual heat wave to pass down about twenty times more quickly than the solid land. I believe that if Loch Fyne were 800 feet deep there would be no seasonal change of temperature at the bottom, and this state of matters is actually found in the deep Norwegian fjords.

The Clyde Sea Area work* shows clearly that the configuration of the bed of the sea has a most important effect in modifying the process of seasonal change of temperature.

In the cases just considered the bodies of water are all very much under the control of the land, and do not represent the typical *régime* of an unbroken water surface. In the open ocean we find that the water is warmed and cooled almost entirely by radiation, the cooling extending to the bottom, the warming being usually restricted to the upper layers. The average temperature of the whole ocean is about 40°, but at the bottom from the poles to the equator it is within a degree or two of 32°. If it could remain at rest the surface of the ocean would present a broad belt of warm water in the tropics and large areas of cold water near the poles separated by a gradual transition. This is far from being the case. The surface of the ocean is in a continual whirl of movements, sometimes as well-defined currents, again as a vague general drift. These current tracks correspond for the most part with the prevailing winds which largely cause them; but there is no doubt that the ocean currents have in their turn an important influence in determining the course of storms. The interactions are complex and not yet fully worked out. It will suffice to indicate the general result as they have been established for the Atlantic ocean; in the other oceans they appear to be on the whole similar.

Near the equator two great currents run westward across the ocean, one curving southward the other turning northward. The latter, reinforced by the Gulf Stream, continues to turn to the right as it flows and so carries the warm surface water of the tropical regions into the North Atlantic and against the western coast of Europe; the cold return currents from the Arctic regions flow southward along the eastern sides of Greenland and Labrador. A similar circulation takes place in the southern half of the Atlantic, so that the tropical seas are skimmed of their warm upper layer to north and south, and an up-welling of the deep cold water from below takes place along the West African coast. Equilibrium is maintained by slow under-currents from the polar regions. The curious anomaly is thus brought about, that under the equator cold water is found nearer the surface than anywhere else, while in the North Atlantic off the British Islands, the deep water which has accumulated is warmer than in any other part of the ocean.

The changes of surface temperature with season in the North Atlantic are very marked, the range between the coldest month, February, and the hottest, August, being 20°. This is mainly due to a change in the direction of warm and cold currents, the annual range of temperature in few parts of the ocean exceeds 10°, and is often 5° or less. The diurnal range is only about 1°, as the water heats and cools very slowly, mainly on account of the rapid evaporation during sunshine. The effect of the whole system of oceanic circulation is to equalize the distribution of temperature, by warming the temperate and cooling the torrid zones. I have shown that the mean annual surface temperature of the water off the West coast of Scotland is 2° higher than that of the overlying air.

---

* See "Transactions Royal Society of Edinburgh for 1893."

These considerations clear the ground for the study of air-temperature, a department more difficult than the other two because it depends upon them, and also on a number of other variable conditions, some of which have been already mentioned. Since the air pressing alike on land and sea is largely dependent for its heat on the warmth of the floor supporting it, we see at once how the different thermal values of land and sea must affect the local climates. Broadly speaking, the land is hot in summer and the sea much cooler, while the land is cold in winter and the sea much warmer; the summer and winter of the two hemispheres being alternate, we find that the land is hot in the northern hemisphere while it is cold in the southern, and *vice versâ*.

The most paradoxical thing in meteorology, is that the higher one goes in the atmosphere the colder it becomes, not only at night, but during full sunshine; and with the solar radiation becoming more intense. Fortunately this can readily be explained. The atmosphere diminishes in density as we ascend, and the less dense air is more diathermanous, the diathermic power of the upper air being also increased by the absence of the large proportion of water vapour which exists at lower levels, and by the smaller amount of dust. So that we find the sun's heat passes through the upper air without warming it, as light passes through a clear sheet of glass. It might seem reasonable to expect that currents of hot air rising, as such currents always do, would carry up heat by convection; but all the heat they can carry, and all that is set free by the condensation of their vapour into cloud or rain, is required to produce the expansion which the reduction of pressure renders necessary. On a high plateau and even on mountain peaks, when not snow-clad, the intensely powerful solar radiation heats the land enormously during the day, and this in turn warms the air to a higher degree than that corresponding to the altitude.

Down in the denser stratum of air which lies next the surface of the Earth, radiation is absorbed by the vast multitudes of dust particles, most rapidly by the largest, and since such particles when coated with condensed water form clouds, the interposition of a stratum of cloud may absorb or reflect upward all the radiation, and growing warmer itself, prevent any perceptible heating of the ground, thus checking the heating of the air near the surface. On the other hand, the existence of clouds at night acts as an equally effective screen to the radiation of heat from the cooling ground, and so prevents loss of heat in the lower strata of the air. The dense lower air is itself, especially when charged with dust and water vapour, very much less diathermanous to the long wave-length radiations from the land, than to the shorter waves of radiation from the sun, thus the air itself forms a sort of blanket to the Earth, while the clouds with which it is often laden, may be compared to a down quilt laid on above. The case of a greenhouse is still more to the point, the dense surface air, like the glass, allows heat to enter freely, but retards its escape when transformed to radiations of a greater wave-length.

These considerations explain how the extreme theoretical range of surface heating and cooling of the land only prevail in places where the atmosphere is especially clear and free from water-vapour which might form cloud. They explain also how the minimum temperature which is experienced on a clear night depends on the amount of water-vapour present. For as soon as the vapour becomes saturated by the fall of temperature, it condenses, and the heat thereby liberated prevents further cooling. They explain also, why in trying to arrive at the exact succession of temperature changes during a day or a year, it is necessary to take the mean of many observations, so that local abnormality caused by exceptional cloud or moisture may be eliminated.

The average fall of temperature with increasing height may be taken as about 1° F. for every 300 feet (in the case of Ben Nevis 1° in 270 feet is nearer the truth), but there are many local irregularities largely dependent upon disturbances of the normal vertical distribution of pressure. In winter it often happens that in very still clear weather the surface of a mountain slope becomes greatly chilled, and thereby cools the air immediately resting on it, producing a very dense cold stratum which flows like water down the slope, accumulates in the valley, and so reverses the usual temperature gradient. For general purposes of the comparison of climates, it is usual to reduce the temperature readings to their theoretical value at sea-level before drawing isotherms on a map. Thus, in interpreting an isothermal map, one must divide the height of any place in feet by 300, and deduct the resulting number from the temperature represented. The July isothermal map, for instance, shows the air temperature on the Pamirs as 95°, but the height there is 18,000 feet, so that 60° have to be deducted for altitude, leaving 35° as the mean value of the air temperature for the month.

The air is usually coldest in the early morning just before sunrise, and warmest in the early afternoon, the latter fact corresponding with the mainly indirect way in which solar radiation warms the air by the intervention of the previously heated ground. The diurnal range over the open sea is naturally very small on account of the equable temperature of the water in contact with it, while the diurnal range over bare land is the greatest, closely corresponding to the extreme soil surface temperatures. The diurnal march of temperature is most marked and regular in the tropics; at Batavia, for example, the minimum occurs about 6 a.m., and the maximum about 1.15 p.m., giving 7¼ hours of rapid heating and 16¾ hours of much more gradual cooling. In temperate regions the minimum occurs earlier in summer and later in winter than is the case in the tropics. At Christiania the July hours are 3.30 a.m. for minimum, and 3 p.m. for maximum, giving 11½ hours heating and 12½ hours cooling, while in January the hours are 8.10 a.m. for minimum, and 1.30 p.m. for maximum, which gives only 5⅓ hours of heating and 18⅔ hours of gradual cooling.

In order to compare the temperature of places for any day at least two data are necessary, the mean temperature for the day and the range or difference between the highest and the lowest. The latter is particularly important from a hygienic point of view. It is given by the difference between the readings of the maximum and minimum thermometers for the day in question. The average of the maximum and minimum temperatures is usually about half a degree higher than the average of the temperatures if taken hourly throughout the day. The interesting fact has long been known that the mean of any two hours of the same name is practically the same as the average of the day, thus when only two observations can be taken they should be at 8 a.m. and 8 p.m., 9 a.m. and 9 p.m., or 10 a.m. and 10 p.m., nine o'oclock observations being usual in this country. Diurnal range of air temperature is mainly dependent on proximity to the sea, the nearer the sea the less it is, the farther inland the greater. In places like Western Europe where the prevailing wind is from the sea, the range of temperature may be reduced far inland, unless mountains intervene, while in places where as in Eastern Asia, land winds prevail, a comparatively high range may be found even in the air temperature of islands. In England the daily range (mean annual) varies from 8° in the oceanic climates of the west to 16° in the more continental climate of the south-east.

Although I must not trespass on the domain of the winds in this lecture, it is necessary to call attention to one of the most interesting instances of that system of interaction and compensation which gives a despairing fascination to meteorology. Land and sea breezes are familiar phenomena along all mountain slopes which face a tropical sea, the surface wind blowing from the cool sea to the hot land during the day, and from the cold land to the warm sea at night, tending to equalise the air temperature. The cause of this is usually said to be the draught caused by hot air resting upon and flowing up an inclined surface; and the reverse effect of cold air flowing down a slope. The same phenomena are found in all mountainous regions, where the day winds blow uphill and the night winds down.

The larger seasonal variations of temperature in the air follow in a similar way the variations in the warmth of the land or sea on which it rests, the geographical distribution of climate being very clearly marked in its broad features. Perhaps the most perfect illustration of the contrast between oceanic and continental climates is to be found within the Arctic circle at two places having the same latitude, the Lofoton Islands on the west of Norway, and the village of Verkhoyansk in the centre of northern Asia. Both places receive the same amount of solar radiation, but at Lofoton it is largely retarded by clouds, and the prevailing strong south-westerly wind is always carrying in air that has gained its temperature from the warm and equable surface of the North Atlantic. At Verkhoyansk on the other hand there is little moisture or cloud, the winds are light, land lies all round, and radiation has its full effect. In winter the frozen soil radiates away its heat and chills the air resting on it, which thereby grows denser and so remains pressed against the cooling ground, its mean temperature in January approaching—60° (*i.e.*, 92° below the freezing point), the lowest mean known to exist. In summer after the snow has melted the surface soil thaws and heats up rapidly, although a few feet beneath there is perpetual ice, and the air warmed by the hot ground attains in July the comparatively high temperature of 60°.

At Lofoton the mean January air temperature does not fall below 32°, the July temperature is 48°, showing an annual range of 16°, while at Verkhoyansk the range is 120°. It appears that Lofoton is warmed all the year round by convection currents, which owe their heat to tropical radiation, but involve clouds checking local radiation, while Verkhoyansk has to satisfy itself with its own small thermal income, in the face of an abnormally enhanced demand for the expenditure of heat by radiation.

The isothermal maps of the world for the extreme months, January and July, and for the average of the year show, by the departure of the isotherms from the parallels, in what regions extensive borrowing of heat from warmer climates occurs, and where undue withdrawals of heat by the indraught of cold air in winter take place. It is impossible without these maps to explain the distribution of climate, beyond saying that in the northern hemisphere the north-western coasts of the continents are abnormally warmed, and their climates rendered equable, while the north-eastern coasts are correspondingly chilled.

The mean air temperature for each degree of latitude has been calculated, and if the heating of some regions is held to balance the chilling of others, a diagram representing the mean temperatures of each parallel would show the normal effect of solar radiation as distributed on the globe. Thus for the latitude of London (say 51° N.) the radiation temperature of the air in January would be 20° F.; as a matter of fact the mean air temperature for London is about 40° in January, showing that the air is heated 20° by the south-westerly wind warmed by the Gulf Stream and other warm currents of the North Atlantic. We enjoy the same mean winter temperature as the people of Lyons (46° N.), Venice (45° N.), Constantinople (41° N.), and Shanghai (31° N.), in other words the oceanic influence is worth on the average 10°, and in some cases 20° of latitude in winter. In July we experience the other side of the transaction, the average temperature of London in that month may be taken as 64°, which is a few degrees lower than the radiation temperature for the latitude, and equivalent to the climate in that month of St. Petersburg (60° N.), and Yakutsk (64° N.), so that in summer we experience the climate of Northern Europe, in consequence of the marine influence which is equivalent to a 10° shift of latitude. Nothing could more strikingly demonstrate the value of these redistributions of solar energy than the fact that we in London without moving from home spend our winters on the Mediterranean and our summers close to the Arctic circle. In Labrador the conditions, especially as regards winter, are reversed.

Taken degree by degree of latitude, the northern hemisphere has a much greater range of air-temperature than the southern, the obvious reason being the excess of land in the north, and the corresponding predominance of continental conditions. At high southern latitudes there are no extremes; the Falkland Islands have a winter temperature of about 35° in July, and a summer temperature of barely 50° in January; the range of temperature for the year being scarcely half that of London, which in turn is only one-quarter of that of Irkutsk in the same latitude. For comparing the annual climates as for the diurnal, we require to consider the annual range of air-temperature as well as the annual mean.

While the facts I have referred to hold good for wide stretches of country, the distribution of temperature locally is full of curious exceptions and anomalies, sometimes of great practical importance.

In the British Islands alone there is room for considerable variety of climate. During January the average temperature varies from under 38° in the east of Scotland and of the North of England, to over 45° in the south-west of Ireland; and the isotherms as a rule run from N.W. to S.E., showing that the main source of heat in that month is not solar but oceanic. The line of 39°, for example, runs through Shetland, Orkney, Ayr, Chester, Oxford and London; all to the east of that line is colder, all to the west is warmer. When in summer the greater altitude of the sun asserts its influence the isotherms run more nearly east and west, but for July they form a series of north-pointing convex curves, showing the greatest warmth in the centre of the country, and a pronounced chilling effect along the coasts. Thus the isotherm of 62° runs from near Swansea on the west coast as far north as Sheffield, and bends south again, under the influence of the North Sea, to Harwich. The line of 54° runs through Shetland, while London has a temperature of 64°; showing, since the winter temperature of those two points is the same, that the greater oceanic influence round Shetland has restricted its annual range by 10° as compared with London.

Local climate depends on many conditions which may, if favourably combined, lead to great differences from the average conditions of the region. A high situation ensures lower temperature and, according to exposure to the wind, clearer or cloudier air all the year round. Exposure, or the slope of land towards or from the sun, has a most powerful effect on soil-temperature, and thus on the warmth of the air. If the land slopes towards the south (in the northern hemisphere), the mid-day sun strikes it more nearly at right angles, and the effects of insolation are stronger than if the land were horizontal or sloped northward. If the height of the sun were 43°, for example, land sloping south at an angle of 36° would receive 73½ per cent. of the heat that would be experienced if the rays fell perpendicularly to the surface, while land sloping northward at the same angle would receive only 1 per cent. of the heat of perpendicular rays. Shelter is another extremely important factor, especially when the climate is influenced by prevailing cold winds. In such a case, a site to leeward of a hill, or still better, a flat ground surrounded by steep cliffs of light coloured rock facing the south or south-west, would in this country ensure a temperature many degrees higher than that of neighbouring places with less favourable exposure. This would give a relatively warmer climate, but warmth does not necessarily mean healthiness, indeed, the stagnation of air in warm sheltered valleys may become a direct cause of disease.

Warmth seems to bear a less close relation to health than any other component of climate, or it may be safer to say that temperature acts differently according to the condition of the atmosphere with regard to moisture and wind. Intense heat may be borne in Australia without injury to the health of the individual, or the permanence of the race, a much lower temperature in tropical Africa would be accompanied by great risk to life. Similarly very low temperatures such as those of winter in the Arctic regions, produce no bad effect on healthy men with abundant food, suitable clothing, and exercise, the Arctic climate being esteemed one of the healthiest in the world. Travellers have journeyed for months in Northern Canada, sleeping out on the snow with very slight covering, while the air temperature was 30 or 40° below zero; while on the other hand, people have been killed by the cold in this country at temperatures not much below the freezing point. The cold of Verkhoyansk where the temperature sometimes falls to 70° or more below zero, is probably much more severe than that of the North Pole, yet it is a permanently inhabited village. Cold alone, we may safely say, will never interfere with Arctic exploration.

Sudden changes of temperature are always trying to health whether they occur by a sudden fall or rise of temperature at home, or by a person accustomed to one climate removing to another which is much more extreme. When combined with excessive moisture high temperatures invariably produces bad effects, and moist cold is also very injurious, but probably as severe a climatic trial to health and temper as any is the sudden setting in of a raw east wind in the course of a genial English spring, or the occurrence of a spell of intensely hot weather in the course of an average English summer. In this connection I must take exception to the somewhat tempting comparison of death-rate and temperature curves as a criterion of the influence of temperature on health. No doubt coincidences occur in the seasonal fluctuations of death-rate and temperature, but temperature is only one of the periodic components of climatic change, and it is very doubtful whether the actual value of the temperature in itself greatly affects health.

One curious circumstance with regard to the seasonal march of temperature in this country at any rate is the occurrence of breaks in the course of heating and cooling, cold spells interrupting the regular annual rise of temperature or accelerating its fall, and warm spells interrupting its regular fall or hastening its rise. Thus periods of exceptional cold usually occur in the second week of February, April and May, at the end of June, and in the second weeks of August and November, and periods of unusually warm weather in the first half of July, August, and December.

In conclusion, I must insist once more on the fragmentary part which temperature plays in climatology, and on the importance of considering all climatic phenomena in making comparisons or generalisations. Warmth is important, but wind, rain, cloud, fog, and sunshine are all of them important too, and no one of these conditions can truly be viewed as independent of the others. It is necessary in following one of the ramifications of the nervous system of climate to dissect it out and trace its main direction, and this is all that so brief a course of lectures permits; but a true study of meteorology would aim at subsequently re-uniting the severed connections and establishing the inter-relations of all the parts in the unity of the whole.

I have refrained from the attempt to give credit to the many physicists and meteorologists on whose labours such a summary as this depends, because it is difficult without being diffuse to trace the share each has had in developing the science. An excellent little book on Meteorology has recently been published by Mr. H. N. Dickson, which serves as a useful introduction to the highly practical *Meteorology* of Mr. R. H. Scott, and the *Weather* of the Hon. Ralph Abercromby, as well as to the more theoretical *Modern Meteorology* of Professor Waldo, who first in English has expounded the labours of the great German theorists Von Bezold and Zenker, and to the *Elementary Meteorology* of Prof. W. M. Davis. An attempt to correlate the activities of the atmosphere with those of the Earth as a whole is made in my *Realm of Nature*, and for the innumerable studies, experiments and theories, which are being carried on in this country bearing on the natural distribution of temperature, it is sufficient to refer to the *Journals* of the Royal and of the Scottish Meteorological Societies, and to Symons' *Meteorological Magazine*.

[The lecture was illustrated throughout with a series of meteorological diagrams and maps, for the use of several of which the lecturer was indebted to Mr. H. N. Dickson.]

BAROMETRICAL CONDITIONS AND AIR MOVEMENTS.

BY R. H. SCOTT, F.R.S., F.R.MET.SOC., &C.

Being the third of a series of lectures on Meteorology in relation to Hygiene, April 3rd, 1894.

IN dealing with the subject of barometrical conditions, and air movements as related thereto, before my present audience, I feel some slight difficulty, as it is not at first sight easy to see how either the barometrical pressure or the wind has any direct sanitary effect, except as, in the case of the former, by influencing the tidal level, and thereby river drainage, or as in the case of the latter, by occasionally bringing to us odours, not of Araby the Blest, when the wind comes to us from certain definite quarters.

The lecture naturally divides itself into two sections: the Pressure and the Wind, and I shall take them in the sequence in which I have named them. Pressure I shall deal with, firstly, as to its periodical and its non-periodical changes; and secondly, as to its physiological effects and the modes of counteracting them.

The periodical changes are those which recur at regular intervals, such as a day or a year; the non-periodical, those which are uncertain in their appearance, like storms.

The daily change, or the Diurnal Oscillation, as it is called, is of small extent in these islands, only amounting to about 0·02 in. on the mean of the year; but at Calcutta, for instance, its amplitude reaches nearly six times that quantity, being 0·116 in. In very high latitudes the phenomenon almost disappears. As Herschel says ("Meteorology," p. 163): "The diurnal oscillation is a phenomenon which invariably makes its appearance in every part of the world *where the alternation of day and night exists* . . . . within the arctic circle, however, the diurnal oscillation dies out, or rather merges in the annual."

The phenomena of the diurnal variation are a marked feature of the meteorology of the Torrid Zone. It is even said that in those latitudes you can set your watch right, within twenty minutes, by the barometer reading on any day. Any irregularity in the recurrence of the rise and fall is a sure sign of the approach or proximity of a storm of some sort.

The ordinary type of curve exhibits two maxima, at about

9 a.m. and 9 p.m., and two minima, at about 3 a.m. and 3 p.m., but these epochs are not quite the same at all stations. Speaking generally, we may say that the movement of the barometer is greater during the day than during the night. This shows *inter alia* that the barometrical curve is related to that of temperature.

If the curves of temperature and of pressure be laid down on the same paper, the relation between them comes out in a very clear light. Where the diurnal amplitude of temperature is slight, as at Valencia in Ireland, the minimum at 3 a.m. is more marked than that at 3 p.m., while at Kew Observatory, where the thermometer range is much greater than at Valencia, the reverse relation holds, and the curve approaches its continental cahracter. As an aggravated illustration of this continental character I may refer to the curve for Nertschinsk in May, shown on a diagram in my "Elementary Meteorology," where the morning minimum is almost obliterated.

The annual range of pressure is exhibited for three stations in another diagram in the same book. It will be seen from it that while in these islands, and over the Atlantic, near the Equator, the curves show few marked peculiarities, in Siberia the line follows a very striking course, the pressure falling as much as 0·7 in. from January to June, and the descending branch of the curve being much steeper than the ascending. This marked change of pressure is certainly related to the excessive dryness and heat of the Siberian and Central Asiatic steppes in the summer time.

So far for the periodical changes, which have not as yet been shown to influence health to any material extent.

It is otherwise with the non-periodical changes, or the oscillations of the barometer accompanying changes of weather. These certainly affect health in various ways, as we shall proceed to explain. This non-periodical range of the barometer depends in great measure on latitude, but with the limitation that its greatest amplitude occurs about the 60th parallel of latitude. In the tropical regions of the Atlantic the extremes, taken from a very large accumulation of barometrical readings, varied by only 0·4 in., or thereabouts. In these islands the variation is about nine times that amount, being over 3·7 in., the reading of 31·046 ins. having been recorded at Gordon Castle, Banffshire, in January, 1820; and one of 27·33 ins. at Ochtertyre, Perthshire, January 26th, 1884.

The Barometer Manual for Seamen contains a table showing this variation of range for different latitudes from 60° N. to 55° S.

You will see, therefore, from what has been said, that, as regards the diurnal range, it is greatest in low latitudes; that the annual range is greatest in Central Asia, and that the non-periodical range is greatest in high latitudes.

As regards the physiological effects of the last named phenomenon, many of my hearers are doubtless well acquainted with Dr. Jenner's famous lines on the signs of a change of weather, in which the following occur:—

Last night the Sun went pale to bed,
The Moon in haloes hid her head;
The boding shepherd heaves a sigh,
For, see! a rainbow spans the sky:
The walls are damp, the ditches smell,
Closed is the pink-eyed Pimpernel:
Hark how the chairs and tables crack!
Old Betty's joints are on the rack:
Loud quack the ducks, the peacocks cry,
The distant hills are looking nigh.

In this, rheumatic pains are distinctly cited among the signs of rain or of an approaching barometrical depression.

It may, therefore, be of interest to state briefly what is known of the physiological influence of changes of pressure.

The most obvious ways of exposing the human system to increased or diminished pressure, are by descending a mine or ascending a mountain. The descending a mine, or, what is much worse, working in a diving bell or a caisson, produces "caisson disease," possibly resulting in paralysis and death.

The scaling a mountain, or ascending in a balloon, may produce "mountain sickness," and in the case of the French aeronauts, in 1875, MM. Croce-Spinelli and Sivel, the rarefaction of the air at the height of about 28,000 feet, equivalent to that of the highest of the Himalayan peaks, produced death. It was the same action which made Mr. Glaisher collapse on his famous ascent from Wolverhampton with Mr. Coxwell, Sept. 5th, 1862.

I shall treat first of the effects of reduced pressure, and the persons who have investigated this subject most thoroughly are the late M. Paul Bert, as far as laboratory experiments go, and Mr. Edward Whymper, by actual practice, on his visit to the great Andes of Ecuador in 1880.

M. Paul Bert found that when he had reduced the pressure of the air in his air-tight chamber until it was about equal to that experienced at the top of Mount Everest, the difficulty in breathing was greatly relieved by inhaling oxygen from a reservoir specially provided. The two gentlemen whose names I have just mentioned, Messrs. Croce-Spinelli and Sivel, having gone through the experience of the air-chamber, proceeded to test the effect of the natural reduction of pressure in a balloon ascent, to about the same degree of rarefaction as they had sustained in the laboratory, but, as has been said, they fell victims to their temerity.

M. Paul Bert accounted for the mishap by stating that they had not taken enough oxygen with them.

Mr. Whymper's experiences are most interesting. His first attack occurred not at the highest level he reached, but at 16,000 ft. It came on absolutely without warning. He says:

"We ourselves were in good condition—as was to be expected, as we had ridden most of the way; but in about an hour I found myself lying on my back, along with the two Swiss guides, placed *hors de combat* and incapable of making the least exertion." The principal symptoms were, "We were feverish, had intense headache, and were unable to satisfy our desire for air, except by breathing with open mouths."

The remedy which Mr. Whymper administered to himself and his comrades was chlorate of potash, a salt which, as is well known, parts with its oxygen very easily. Mr. Whymper tells us that this same salt was freely munched by the members of Sir D. Forsyth's Expedition to Yarkand in 1873.

Mr. Whymper, however, is not disposed to attribute his recovery simply to the extra consumption of oxygen. He considers that a great deal of his subsequent immunity from similar attacks was due to his gradual acclimatization to the atmosphere of the upper levels of the mountain range which he was then frequenting.

I remarked in confirmation of this last remark of Mr. Whymper, that very recently Mr. Inwards, the President of the Royal Meteorological Society, gave us a very interesting address on the meteorology of the upper air, and in it narrated his experience of a residence in the Andes at a level of some 13,000 feet. He says, "In these high plains of the Andes we get a good opportunity of studying the effects of rarefied air upon animal life, and one of the first things we should expect in people who have to live in an atmosphere which only allows them to take in about two-thirds of the usual quantity of oxygen each time they breathe, would be that they would be sure to suffer from lung troubles, and that strangers coming from lower levels, where they had been accustomed to a full supply of that prime necessary of life, would fall ill or pine and die. Our surmises, though apparently founded upon reason, would be woefully wrong, for we should find ourselves among a people to whom lung diseases are almost unknown, who have no words in their language for consumption, or catarrh, and who go about their daily occupations without even suspecting that they are badly used in being deprived of so large a portion of their atmosphere. As to the stranger who arrives among them, after the first inconvenience caused by the sudden change, he generally improves in health, and if he had any chest disease when he came, he generally promptly loses it.

"We find the man (I speak of the Aymara Indians, among whom I lived) to be a large-chested and rather short-legged race, with a great capacity for prolonged and patient exertion, but with no great aptitude for great or sudden efforts."

Mr. Inwards adds, as his own experience, that "exertion soon becomes fatiguing, and only a few yards running will cause a stranger to pant for breath," and in this he exactly confirms Mr. Whymper's experience.

As regards the opposite effects of increase of pressure, these have been studied more especially in the United States, where apparently caissons are more commonly used in foundation laying under water than is the case over here.

The symptoms were first felt in diving-bell work, but as these machines have gone out of use, owing to the impossibility of ventilating them, air-tight chambers are now employed, access to which is maintained by means of air-locks.

In these, men can work for several hours together, but on leaving the caisson for the open air very unpleasant symptoms come on, and the more seriously the more rapid the reduction of pressure.

The symptoms are thus described: "Severe, often excruciating, pains, coming on suddenly, commencing in, or near, both knees, and extending upwards into the trunk, associated with gastric pain and vomiting." The pain principally affects the muscles. In some cases it is followed by paralysis and by death. New comers and full-blooded men are more prone to the attacks than others, and severe exertion, such as climbing a ladder quickly, or exertion on leaving the tube, is a serious predisposing cause for seizure.

For further accounts of this disease, and of the therapeutic effects of compressed air-baths, I must refer my audience to medical works, such as the recently published "Äero-therapeutics" by Dr. C. Theodore Williams.

I shall, however, make some quotations from this volume. As to the advantages to be gained by the use of compressed air, Dr. Williams tells us that "the voice becomes shrill, and singers often gain a note or two higher than their ordinary average, in the bath." We may, therefore, expect a compressed-air bath to be one of the "properties" at Drury Lane next season.

Speaking seriously, we find further on that the principal effect of the baths on asthma appears to be sedative to the pulmonary plexus of nerves and to the pneumo-gastric. The attacks are rendered less severe, and after a course of twenty or thirty baths the intervals between the attacks become much longer. . . . . "The effect on the paroxysm is immediate and wonderfully efficacious, in fact more so than any medicines, and many asthmatics have expressed to me the wish that they could live in the bath and thus be freed from their sufferings."

This last remark is interesting. It is well known to many of us that there is a great difference between asthmatic patients, some of them declare that they can breathe freely only in a fog, while others suffer more in foggy than in clear weather. It would appear from Dr. Williams' statement that the real agent in affording relief is not the fog but the anticyclone which brings it on.

With this I shall leave the subject of pressure. You will, however, have gathered from what has been said that the human system cannot with impunity be exposed to any serious changes of atmospheric pressure, whether these be due to a fall or to a rise of the barometer.

We now come to the second portion of our subject, the movements of the air. That these are related to the conditions of pressure is well-known to everybody. Air is an elastic body, and if the pressure in any part of it is reduced the surrounding portions press in until equilibrium is restored.

The air motion, thus set on foot, is affected by the rotation of the earth on its axis, and it therefore is affected in opposite ways on opposite sides of the Equator. The Law of Motion is known as Buys Ballot's Law, and it is thus stated:—

Stand with your back to the wind and the barometer will be lower on your left hand than on your right.

This is the law in the Northern Hemisphere, in the Southern it is exactly reversed.

So much for the relation of the wind to barometrical pressure, but the subject we have to discuss is the action on ourselves of the wind when it has once started on its course.

We all know the common saying:

When the wind is in the East,
'Tis neither good for man nor beast.

And we, some of us, may have heard of the Boat Cough of St. Kilda, which was said to come on in that island whenever visitors from the Hebrides, lying to the eastward, landed there. This was before the days of steamers, and then but few smacks or hookers went to St. Kilda unless with a steady Easterly wind. This is a somewhat rare wind in those parts, and on the principle of *post hoc, ergo propter hoc*, it was associated in common belief with bronchial affections. Now that visitors are no longer solely dependent on wind for their access to the island the stories of Boat Cough have died away.

The belief in meteorological causes for most of the ills which flesh, and, for that matter, soul too, is heir to, has found recently an advocate in a Dr. Crothers, of Connecticut. This gentleman states that he himself is frequently amazed at "the faulty deductions and misconceptions" he makes in damp foggy weather. He goes on to state "that the amount of work turned out of a Connecticut factory on damp days, and days of threatening storm, is said to be from ten to twenty per cent. less than when the air is clear and the sky bright." As to the influence of warm weather and hot winds, it is asserted "that the arrests made by the Chicago police exactly correspond in number with the height of the thermometer."

This opens a copious field for contemplation, but Mr. Ruskin, in his "Storm Cloud of the Nineteenth Century," has done much of this speculation for us. Speaking of the wind which brings this storm cloud, he says, at p. 43:

"This wind is the plague wind of the eighth decade of years in the nineteenth century, a period which will assuredly be recognised in future meteorological history as one of phenomena hitherto unrecorded in the courses of nature, and characterized pre-eminently by the almost ceaseless action of this calamitous wind." In the "Fors Clavigera" for August, 1871, he had already said of the same wind: "It looks partly as if it were made of poisonous smoke, very possibly it may be; there are at least 200 furnace chimneys in a square of two miles on every side of me. But mere smoke would not blow to and fro in that wild way. It looks more to me as if it was made of dead men's souls—such of them as are not gone yet where they have to go, and may be flitting hither and thither, doubting, themselves of the fittest place for them."

"You know if there *are* such things as souls, and if ever any of them haunt places where they have been hurt, there must be many about us, just now, displeased enough."

I need scarcely say that this last sentence referred to the Franco-German war of 1870—71.

Mr. Ruskin goes on to say about this wind:

1. "It is a wind of darkness . . . . whenever and wherever the plague wind blows, be it but for ten minutes, the sky is darkened immediately."

2. "It is a malignant quality of wind, unconnected with any one quarter of the compass. It blows indifferently from all, attaching its own bitterness and malice to the worst characters

of the proper winds of each quarter. It will blow either with drenching rain or dry rage from the south; with ruinous blasts from the west; with bitterest chills from the north; and with venomous blights from the east."

3. "It always blows tremulously, making the leaves of the trees shudder as if they were all aspens, but with a frantic fitfulness which gives them (and I watch them this moment as I write) an expression of anger as well as of fear or distress."

4. "Not only tremulous at every moment it is also intermittent with a rapidity quite unexampled in former weather . . . . so that it is often impossible to go on with any kind of drawing in colour, the light being never for two seconds the same from morning till evening."

5. "It degrades while it intensifies ordinary storm."

Now we come to No. 6.

"The most important sign of the plague wind and the plague cloud, that in bringing on their peculiar darkness they blanch the sun instead of reddening it. If you want to see what the sun looks like through the plague cloud, you have only to throw a bad half-crown into a basin of soap and water."

I think the extracts already given are sufficient to show what sanitary effects are in some quarters attributed to certain winds, for Mr. Ruskin says at the close of his "Storm Cloud" that if such a wind as he describes had blown when he was young, none of his books would ever have been written.

We must now proceed to trace this matter of the sanitary action of wind somewhat more thoroughly. As regards the physiological action of winds I have, for the purposes of this lecture, consulted some of the highest authorities in England, and have learned from them that nothing of later years has materially added to the assertions of Hippocrates on the subject, made more than 2,300 years ago. In his famous work περὶ ἀέρων, ἰδάτων, τόπων, of air, water and situation, he deals with winds, and their influences on the character of the nations exposed to them. He dilates at great length on the Scythians and their habit of wearing trousers, which he attributes in part to their cold climate and in part to their habit of riding. It is evident that Hippocrates had no knowledge of Scotchmen and their kilts.

In his book περὶ δίαιτησι (about the manner of life), he says (Clifton's translation):—"The nature of all winds is to moisten and cool the bodies of animals and vegetables, and, therefore, they must all come from snow, ice, hard frosts or hail—rivers and lakes or the earth moistened and cooled. The stronger from the greatest and strongest, the weaker from the least and weakest. For as there is air and wind in all animals, so in all other things there is more or less according to their magnitude. All winds then have the property of cooling and moistening, but by the situation of countries and places through which they pass to particular regions they contract a difference, and so become cold or hot, moist or dry, sickly or healthy. The reason of all this is thus to be understood.

"The North wind blows cold and moist, because it bursts out from places of that nature, passes through such other places as the Sun never arrives at, and so the air not being dried by it the moisture is not sucked up. For this reason it brings with it, wherever it reaches, its natural qualities, unless the situation of the country alters or destroys them. Thus to those who are nearest it is coldest, and mildest to those who are furthest off.

"The South wind blows from places of a like nature with the North, for coming from the South Pole (*ἀπὸ τοῦ νοτίου πόλου πνέων*), and breaking through much snow, ice, and hard frosts or hail, it must needs affect those who live nearest it in the same manner as the North wind, but not the whole country alike that it passes through. For, as it passes through the course of the Sun and under the Equator, the moisture is exhaled by the Sun, and being dried becomes rarefied, so that it cannot but be hot and dry when it arrives there. In the places, therefore, that are nearest, this hot and dry quality must be imparted, as it is in fact in Africa, where the vegetables are dried up and the inhabitants dried insensibly. For, having neither sea nor river to attract moisture from, it attracts that of animals and vegetables; but, when it crosses the sea in this hot and rarefied state, it fills the country it falls upon with much humidity. And therefore, where the situation of a place does not hinder, the South wind must needs be hot and moist. The like may be said of the qualities of other winds."

Much more of the same character might be quoted from the same source, but what I have said shows what a marvellous insight into physical geography Hippocrates possessed. He speaks of cold at the South Pole, using the same term for pole, *πόλος*, as Plato does in the "Timœus," whereas we generally imagine that the ancients thought that the heat increased as you proceeded southwards from Greece, and Herodotus laughed at the idea of the Nile rising in Equatorial snows.

Hippocrates also clearly explains that wind blowing over land is dry, but that if it comes to water it charges itself with moisture, and deposits that as rain on the opposite shore. No modern meteorologist could have expressed himself more clearly and correctly. In fact, the general tendency of modern views of meteorology is to attach much weight to the origin of winds as explaining their character. Some forty years ago it was the fashion to suppose that there were only two currents of wind, the Trade and the Anti-trade, or the Polar and Equatorial currents; and that all the different characters of the wind were fully explained by the different wind roses, the barometrical, thermometrical, and hygrometrical. The introduction of weather telegraphy, and the construction of synchronous charts, led to greater breadth, and increased correctness, of view in dealing with winds.

It soon appeared that East winds were not always dry, whereas, according to Prof. Dove's theories, the East wind was perpetually sucking up moisture on its way from high latitudes to the Tropics, so that no rain could possibly fall from it.

The main action which produces change in the character of the winds, is their being forced to mount up when they meet with any elevation above the surface of the ground. The ascent of air brings it into levels where the pressure is reduced, and the air is therefore rarefied. This rarefaction causes the air to fall in temperature, though this fall is, to a certain extent, counteracted by the latent heat set free by the enforced condensation of moisture. When the air has reached the col, it has no longer to ascend, and the reverse action sets in. The air descends, comes under constantly increasing pressure, and is thereby warmed, while, as the mountain side is not a water surface, it cannot obtain moisture on its way down. It therefore arrives at the plain as a warm and dry wind.

From all this we see that, when any wind sets straight in against a coast line, it is in general wet, and that the bolder and more mountainous the coast is the wetter the wind will be.

In these islands, on the east coast of Great Britain and also of Ireland, it is not an uncommon experience to have copious rain on the actual coast with an east wind, especially with a storm, while a few miles inland no rain falls.

The wettest counties in these islands are those lying to the westward, owing to the prevalence of westerly winds with us. Where the country is hilly, as in the Westmoreland Lake District, the amount of precipitation reaches tropical figures, as much as 129 inches being the average for Seathwaite, above Borrowdale, while the Stye is even wetter.

To give further instances of the action of mountain ranges in, so to speak, squeezing the rain out of what might be thought to be dry winds, we have the South-east Trade of the South Atlantic, generally held to be a dry wind, sweeping across the plains of Brazil until it reaches the eastern flanks of the Andes, where Sara Urcu, one of the eastern peaks of the giant Andes of Ecuador, is almost perpetually veiled in cloud, as the air of the Trade, on reaching the mountain mass, has perforce to rise and be chilled in the process.

In Damaraland, in South Africa, we have a similar state of things, for there the rain bringing winds are the Easterly ones, although they come from the land side, for they are really the South-east Trade of the Indian Ocean, forced to rise when it encounters the hilly ranges on the west coast of South Africa.

We must now turn to the dry winds, and of those the most notorious in Western Europe is the Föhn of Switzerland, known under its other name of *Schneefresser*, the snow eater. This corresponds to the Chinook winds of the Western States of North America.

The intense heat and dryness of this wind are due to its having descended some thousands of feet from the passes over which it crossed the Alps. Its action is such that in places which it visits no baker is allowed to heat his oven during its prevalence. The town of Meiringen, above the Lake of Brienz, which is in a valley forming a sort of funnel leading down from the Grimsel, is specially afflicted by the Föhn, and has more than once been burnt down within the last few years.

Another dry descending wind, long known as the scourge of the Riviera, is the Mistral, or the Italian Maestro.

> Le Parlement, le Mistral, et la Durance
> Sont les trois fleaux de la Provence.

It is a North-west wind, intensely dry, and places exposed to it are most undesirable residences during its prevalence.

When we go further eastward we find wind from the same quarter, known as the Tramontane, on the Lakes of Maggiore and Garda. At Trieste and in Dalmatia it is known as the Bora, blowing so furiously that streets in Trieste are provided with guide ropes to act as bannisters and enable the wayfarer to hold on against the blast, so as not to be blown into the sea. This name Bora may fairly be held to be derived from Boreas, and possibly is related to the Buran of the Russian Steppes, the dread of the winter traveller, for that brings a blizzard of snow with it, and fortunate is he who comes through it alive.

Time would fail me were I to go on to speak of the Scirocco of Southern Europe; of the Simoom, or poison wind (according to Rohlfs) of the desert; of the Khamsin of Egypt, from the Arabic word for fifty, as it blows for the fifty days from Easter to Whitsuntide; of the Harmattan of the West Coast of Africa, bearing clouds of dust to passing ships; of the Brickfielders of Sydney; or lastly, of the "Painter" or "Barber" of Callao, so called from the coating of dust it lays on your face. The names of local winds are almost countless, and the blasts mostly bear an ill repute.

It may be interesting to conclude this lecture by a notice of the origin of the ordinary names of the winds. Quite recently a paper on this subject has appeared in a German magazine, the "Rundschau."

From this we learn that we owe our modern system of combined names—N., N. by E., N.N.E., N.E. by N., N.E., &c.—for the thirty-two points, either to Eginhard, the Councillor of Charlemagne, or to Charlemagne himself. The original scheme, curiously enough, had only twelve points instead of sixteen, for E.N.E., S.S.E., W.S.W., and N.N.W. were all omitted. The idea of compound names has been adopted by all the Northern nations, but not by the Italians or the Sclaves.

The ordinary Italian windrose is:—

N.	Tramontane.	S.	Mezzogiorno.
N.E.	Greco.	S.W.	Libeccio.
E.	Levante.	W.	Ponente.
S.E.	Scirocco.	N.W.	Maestro.

These names evidently indicate the directions from which the different winds come.

Dr. Umlanft, the author of the paper I am quoting, is somewhat fanciful in his etymologies. He traces Scirocco from Syria, the Syrian wind! As to our four cardinal points, he finds that the South wind is now known in Iceland as "Sunnan vinden," or the Sun wind. He derives East from a Sanscrit root, "vas," to shine, and so calls it the light-bringing wind. West comes from a Gothic word, "vis," calm, which does not agree with our idea of the "brave west winds" of the Temperate Zone. Finally, Dr. Umlauft derives North from the participle "noran," of a Gothic verb, signifying to moisten, related to the Greek *νήρος*. This should indicate that the North wind should bring rain, as it does on the northern seaboard of Germany, on the principle already explained, because it blows from the sea to the land.

These derivations are certainly far-fetched, and are evidently framed by a man who thinks that what suits his own climate must be applicable to the rest of the world. I think, however, that you will admit that they present some features of interest.

I hope, finally, that you will carry away from this lecture the idea that the main principle which governs the healthiness or unhealthiness of a wind is whether it is giving back moisture to the earth or evaporating it, and that this depends on whether it is blowing uphill or downhill. If it ascends it is chilled and rain falls, if it descends it is warmed and draws the moisture to itself.

This has been one of the greatest discoveries of modern days, in the way of explanation of the complex actions to which weather and its manifold changes are due.

MOISTURE, ITS DETERMINATION AND MEASUREMENT.

BY W. MARRIOTT, F.R.MET.SOC.

Being the fourth of a series of lectures on Meteorology in relation to Hygiene, May 3rd, 1894.

HYGROMETRY.

THE late Mr. H. F. Blanford, F.R.S., related the following incident that took place in Calcutta some years ago: a gentleman, who had not much acquaintance with science, was sitting one evening with a glass of iced brandy and water before him. It was in the rainy season, when the air, though warm, is very damp, and he had a large lump of ice in his tumbler. On taking it up he noticed, to his surprise, that the glass was wet on the outside, and was standing in quite a little pool of water on the table. At first he thought his tumbler was cracked, but putting his finger to his tongue he found the fluid tasteless. "Very odd!" he remarked; "the water comes through the glass, but the brandy doesn't."

You have all doubtless noticed that immediately on the sudden breaking up of a long frost or spell of cold weather, the walls and almost everything in a house become very damp—so much so that the walls sometimes "run" with water.

The above phenomena are due to one and the same cause, namely, the condensation of the moisture in the air on the cold glass and walls. We thus learn in a simple but very practical way that the air contains moisture.

Various instruments have been devised for determining the amount of moisture present in the air. These are called Hygrometers, which may be classified under the following heads:

A. Hygrometers of absorption.
B. „ condensation.
C. „ evaporation.

Almost anything of a hygroscopic nature, or that will absorb moisture, may be used as a hygrometer of absorption; as, for instance, wood cut across the grain, catgut, the human hair, &c. Catgut is employed in the so-called Dutch "Weather House," in which the figure of a woman comes out in dry weather, and the figure of a man in damp weather. The most reliable of the absorption hygrometers is that known as Saussure's Hair Hygrometer (Fig. 1), in which the variations in the length of a human hair are employed to indicate the changes of atmospheric moisture.

In condensation hygrometers a piece of bright metal or black glass is cooled, until the surface begins to be slightly dimmed by the condensation of moisture, when a thermometer is immediately read off, which gives the temperature of the "dew-point." For Daniell's and Regnault's Hygrometers (Figs. 2 and 3) ether must be used, and for Dines's Hygrometer (Fig. 4) water colder than the dew-point must be employed.

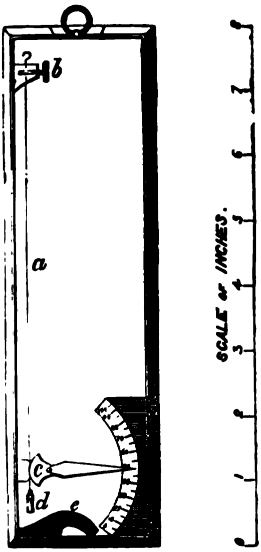


Fig. 1. Saussure's Hair Hygrometer.

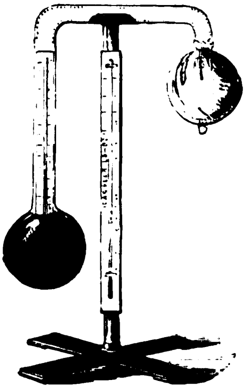


Fig. 2. Daniell's Hygrometer.

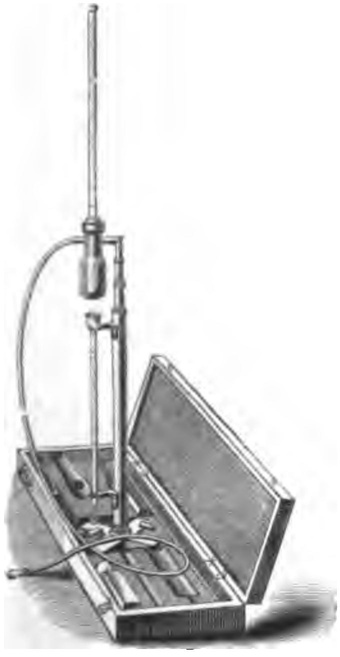


Fig. 3. Regnault's Hygrometer.

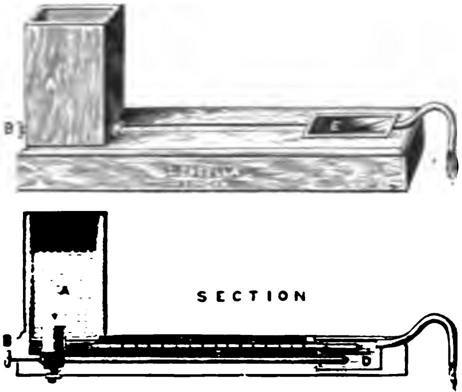


Fig. 4. Dines's Hygrometer.

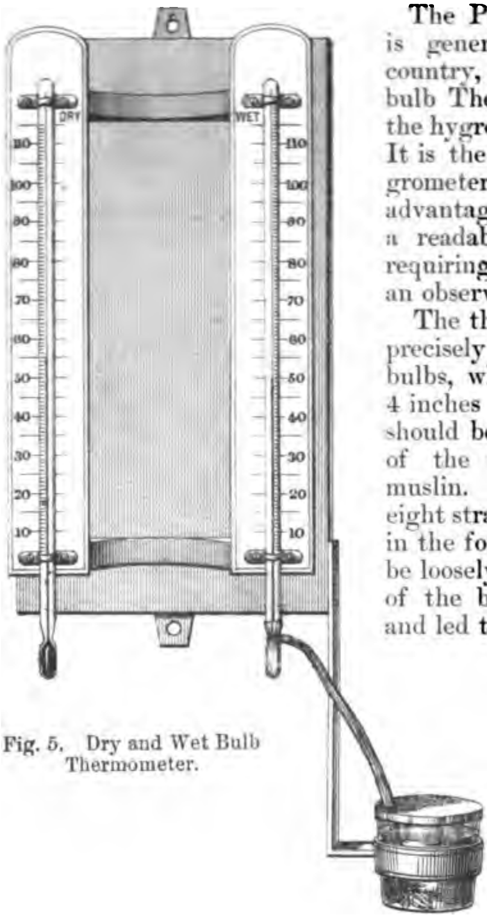


Fig. 5. Dry and Wet Bulb Thermometer.

The Psychrometer, or as it is generally known in this country, the Dry and Wet-bulb Thermometer (Fig. 5), is the hygrometer of evaporation. It is the simplest form of hygrometer, and has the immense advantage of always being in a readable condition and not requiring manipulation before an observation can be made.

The thermometers should be precisely alike and have small bulbs, which should be about 4 inches apart. The wet bulb should be covered with a piece of the thinnest and softest muslin. A conductor of six or eight strands of darning cotton in the form of a noose should be loosely tied round the neck of the bulb over the muslin, and led through a small orifice in the cover of a water receptacle, which should be placed some little distance below the bulb and on the side furthest from the dry bulb. A conical glass cup with a copper lid having a small hole in it should be used, as glass vessels of other forms are liable to be broken during frost. The cup should be kept filled with clean rain or distilled water. The muslin and conducting thread should be washed in boiling water and changed at least once a month; and more frequently if there is any appearance of dirt or deposit upon it. When the temperature is below the freezing point, the wet bulb requires careful management. Instead of a film of water round the bulb, there must be a coating of ice, which can be produced by wetting the bulb with a camel's hair brush; this should be done about an hour before the time of observation.

The quantity of vapour or moisture which the air can contain is dependent on the temperature. The air at a temperature of 32° can contain 2·13 grains of vapour in a cubic foot, at 52° it can contain 4·39 grains, at 72° it can contain 8·27 grains, and at 92° it can contain 15·74 grains. We thus see that the higher is the temperature of the air, the greater is its capacity for moisture. When the full capacity of the air for vapour has been reached, the air is said to be *saturated.* To measure the relative dryness or dampness of the air, we must determine the ratio of the amount of vapour actually present to that which might be present at the existing temperature.

The point of saturation, or the temperature at which moisture would begin to be deposited, is called the "dew point." The amount of the difference between the temperature of the air and the temperature of the dew point shows the dryness of the air, or its capacity for moisture. By means of Glaisher's *Hygrometrical Tables* we can work out from the readings of the dry and wet bulb thermometers the dew point, the elastic force of aqueous vapour, the vapour in a cubic foot of air, the relative humidity, and the weight of a cubic foot of air.

To calculate the relative humidity, we ascertain the elastic force of vapour at the temperature of the air (*i.e.* the dry bulb reading) and also at the temperature of the dew point, and then divide the former into the latter. By neglecting the decimal point, and taking absolute dryness as 0 and saturation as 100, we get the percentage of humidity. This is a popular way of expressing the relative dryness or dampness of the air, but it does not by any means represent the actual amount of moisture present in the air. This, as I have said, depends entirely on the temperature of the dew point.

From an inspection of the continuous records of the dry and wet bulb thermometers, such as those which are obtained at the Greenwich and Kew Observatories, it is seen that not only the temperature of the air, but also the temperature of evaporation, and consequently the relative humidity is subject to considerable variation. Great changes sometimes take place in a very short time, especially during thunderstorms.

The air is dampest or approaches nearest to the point of saturation just before sunrise, and is driest about 1 or 2 p.m. Of course during the day-time the air is drier in summer than in winter, as will be seen from the following figures for Greenwich:—

	January.		July.		Year.	
	8 a.m.	2 p.m.	4 a.m.	2 p.m.	4 a.m.	2 p.m.
	°	°	°	°	°	°
Air Temperature...	37·5	42·0	55·1	70·4	45·2	55·6
Dew point	34·7	36·4	52·3	54·6	42·8	45·1
Relative Humidity..	91°/o	81°/o	90°/o	58°/o	91°/o	68°/o

Low relative humidities are occasionally recorded. For instance, in Death Valley, California, the remarkably low relative humidity of 5 per cent. was observed on the afternoons of August 4th and 5th, 1891. From July 30th to August 9th the humidity did not go above 13 per cent. at the afternoon observations, and averaged only 8 per cent.

At Káshgár, Dr. Scully, on March 7th, 1875, recorded a relative humidity of 6 per cent., the dry bulb reading being 61°·6, and the wet bulb 41°·4

At Allahabad, Mr. S. A. Hill, on May 4th, 1879, recorded a relative humidity of 7 per cent., the dry bulb reading being 111°·6 and the wet bulb 70°·6.

Col. M. F. Ward, with four sets of dry and wet bulb thermometers and two hair hygrometers, recorded at Partenkirchen, Bavaria, on January 27th, 1890, the remarkably low relative humidity of 4 per cent., the temperature of the air being 53°.

It is a common phenomenon in arid regions, and not unknown elsewhere, to see rain fall from the clouds and fail to reach the ground. At such times the condition of the air at the height of the clouds, where there must be saturation, is very different from that at the surface.

Mr. Scott, in the last lecture, referred to the old saying:

"When the wind is in the East,
'Tis neither good for man nor beast."

The East wind in this country is generally a dry wind, and has a considerable capacity for moisture. It consequently abstracts the moisture from human body, and so reduces the temperature.

A good instance of a cold dry spell of weather occurred in March, 1883. The following is an extract from a paper which I read before the Royal Meteorological Society on the subject:—

"The air was particularly dry throughout the month, and especially from the 6th to the 9th, and from the 22nd to the

29th. The mean relative humidity values show that the South coast stations were the driest. The air was driest on Good Friday, the 23rd. The following are some of the relative humidity values for 9 a.m. on this day:—

"44 at Harestock, near Winchester; 49 at Downside, near Bath; 50 at Cheltenham and Marlborough; 52 at Ventnor; and 53 at Bournemouth, Margate, and Southampton.

"Evidently the South coast health resorts were no better off on this day than other places. The winds of the month were bitter and piercing, and being so cold and dry they were correspondingly trying aud injurious."

Sir Arthur Mitchell, in a "Note on the Weather of 1867, and on some effects of East winds," says, "Such winds blowing over a moist surface, like that, for instance, of the human body, tend to reduce the temperature of that surface to the temperature of evaporation, which in this case is much below that of the air itself. In licking up the moisture—that is, in causing its evaporation—a large amount of heat is rendered latent. This heat must be taken from something, and, in point of fact, our bodies are, and must be, almost its entire source. A cold and dry wind, therefore, cools the surface of our bodies, not simply by enveloping them in a cool medium, and warming itself by conduction at their expense. It does this of course; but, being dry as well as cold, it does it with less activity than it would if moist and cold—damp air being a better couductor than dry air. It is chiefly, however, by the other mode that dry cold winds abstract heat from our bodies,—that is, by using their heat in the conversion of moisture into vapour. The heat so used becomes latent, and is for the time being lost. It does not raise the temperature of the air in immediate contact with the body. On the contrary, that air itself, low as its temperature may be, gives up some of its heat to become latent in the vaporised moisture, and probably gives up more than it gains from our bodies by conduction, so that the temperature of the film of air actually in contact with our bodies may be, and probably is, a little lower than the temperature of the bulk. The quantity of heat which our bodies lose in this way is far from insignificant, and the loss cannot be sustained without involving extensive and important physiological actions, and without influencing the state of health. In feeble and delicate constitutions the resources of nature prove insufficient to meet the demand made on them, and a condition of disease then ensues."

Of course you are all aware of the great effect which moisture has upon the human body, and how necessary a dry bracing air is for some patients, while others require a mild and humid climate. Generally, inland districts, which have a great range of temperature, have a lower relative humidity than those in the immediate neighbourhood of the sea-coast, where the temperature is more equable and the moisture in the air more constant.

Mr. Glaisher in his "*Hygrometrical Tables*," says that it would be well for the medical profession to enforce, as far as lies in its power, the use of the dry and wet bulb thermometer, which in case of sickness gives indications so important to the comfort of the patient. If the air be too dry the moisture may be increased by means of a bronchitis kettle. "If, on the contrary, the air be too moist, or should be required to be remarkably dry, all water must either be removed or covered over; and the required degree of dryness obtained by raising the temperature, or by placing in the room sulphuric acid, or any other medium which has the property of rapidly absorbing watery vapour. The instrument in use should be placed in a part of the room away from the immediate influence of the fire, and not exposed to open doors or currents of air; in ordinarily constructed rooms the best place is in a recess on the same side of the room as the fire."

Mr. Glaisher further says that "a difference of from 6° to 8° between the readings of the two thermometers will generally be found to give a pleasant degree of humidity."

The question of humidity is of great importance in cotton mills, as in dry weather the thread will not spin, so artificial moisture has to be injected into the mills in order to make the atmosphere sufficiently humid to carry on the spinning. As this injected moisture, if in excess, is injurious to the operatives, the Government have made it compulsory on the mill owners to have hygrometers in the mills for the purpose of regulating the degree of humidity, which is not allowed to exceed a certain limit.

EVAPORATION.

Having considered the question of the moisture present in the air, let us now turn our attention to the subject of evaporation.

The early forms of evaporation gauges were merely small cylinders or shallow dishes, which were usually mounted on a stand or placed on the ground. During the day the water got heated up very considerably, and consequently these gauges gave the evaporation much in excess of the true amount. The best form of evaporation gauge is a galvanised iron tank about 4 or 6 feet square, and 2 feet deep. This should be sunk in the ground with the top about level with the blades of the grass, and should be kept filled with water to within 2 or 3 inches of the rim. The height of the water should be measured every day, when the difference will give the amount of evaporation. When rain has fallen the amount as shown by the rain gauge should be deducted from the height of the water in the tank.

Observations from such a tank as this were taken at Strathfield Turgiss, Hampshire, by the Rev. C. H. Griffith, under the direction of Mr. Rogers Field, during the fourteen years, 1870–1883, the average annual evaporation being 18·03 inches. The mean monthly evaporation was:—

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
·14	·22	1·04	1·75	2·69	3·05	3·50	2·85	1·60	·78	·36	·05

The greatest amount on any one day did not exceed a quarter of an inch.

This tank was removed from Strathfield Turgiss in 1884 to Camden Square, London, where the observations have been continued by Mr. Symons up to the present time.

Similar observations have been made by the late Mr. C. Greaves, at the East London Waterworks, Old Ford; by Sir John Evans, at Nash Mills, Hertfordshire; and by Mr. C. E. Peek, at Rousdon, near Lyme Regis.

The amount of water passing into the atmosphere by evaporation varies according to the temperature and humidity of the air, the strength of the wind, and the character of the water surface. Evaporation takes place not only from water surfaces, but also from ice and snow, from the ground, trees, plants, &c.

You probably have often noticed that after a shower the pavement on one side of the road sometimes gets dry sooner than that on the other side of the road. This is due not to the air being drier on one side of the road than the other, but to a stronger current of air which is able to lick up more moisture in a given space of time than the lighter current on the other side of the road.

Comparatively very little attention has been given to the subject of evaporation, although it is an important one, especially to engineers and others who have to provide for an efficient water supply.

The evaporation in this country is very small compared with that which takes place in tropical regions, where the nearly vertical sun raises the temperature of vast tracks of ocean to 80° and upwards. The late Dr. W. B. Carpenter, in a paper on "Further Enquiries on Oceanic Circulation" *(Proc. Roy. Geog. Soc.*, 1873—74.) said, "The annual evaporation at Aden is stated by Reclus (though he does give his authority) at 23 feet per annum, which would average about 0·75 inch per day; and I do not see any reason to regard this estimate as too high." Dr. Carpenter also stated that the Red Sea evaporation is at the rate of about 23 feet per annum.

The following figures are interesting as showing the amount of evaporation in several parts of the world:—

Red Sea	276 ins.	Adelaide	56 ins.
Aden	276 „	Boston, U. S.	39 „
Kimberley	100 „	Sydney	36 „
Madras	91 „	Paris	21 „
Great Salt Lake ...	80 „	London	20 „
Nagpur	73 „		

RAINFALL.

We will now consider the question of the precipitation of vapour in the form of rain, snow, or hail.

Mr. Symons has described to us the ordinary rain gauge for collecting and measuring the rainfall. In mountainous districts gauges capable of containing 40 or 50 inches of rain are necessary; these usually have a float inside, the height of which is measured by a rod.

There are two patterns of self-recording rain gauges which may be mentioned. 1st. The Beckley rain gauge (fig. 6) is the

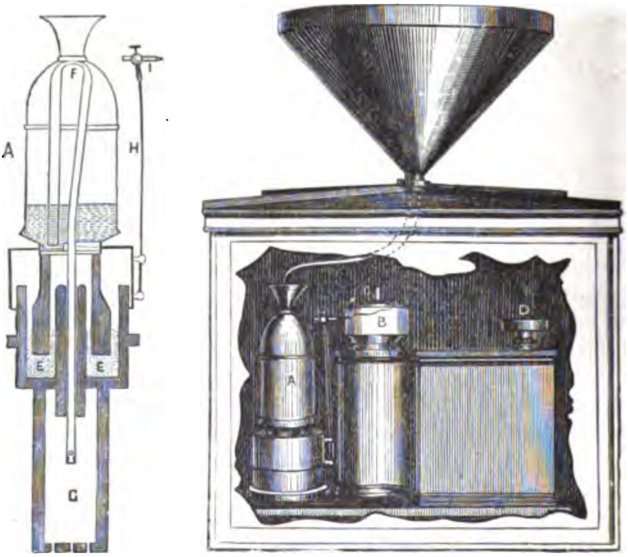
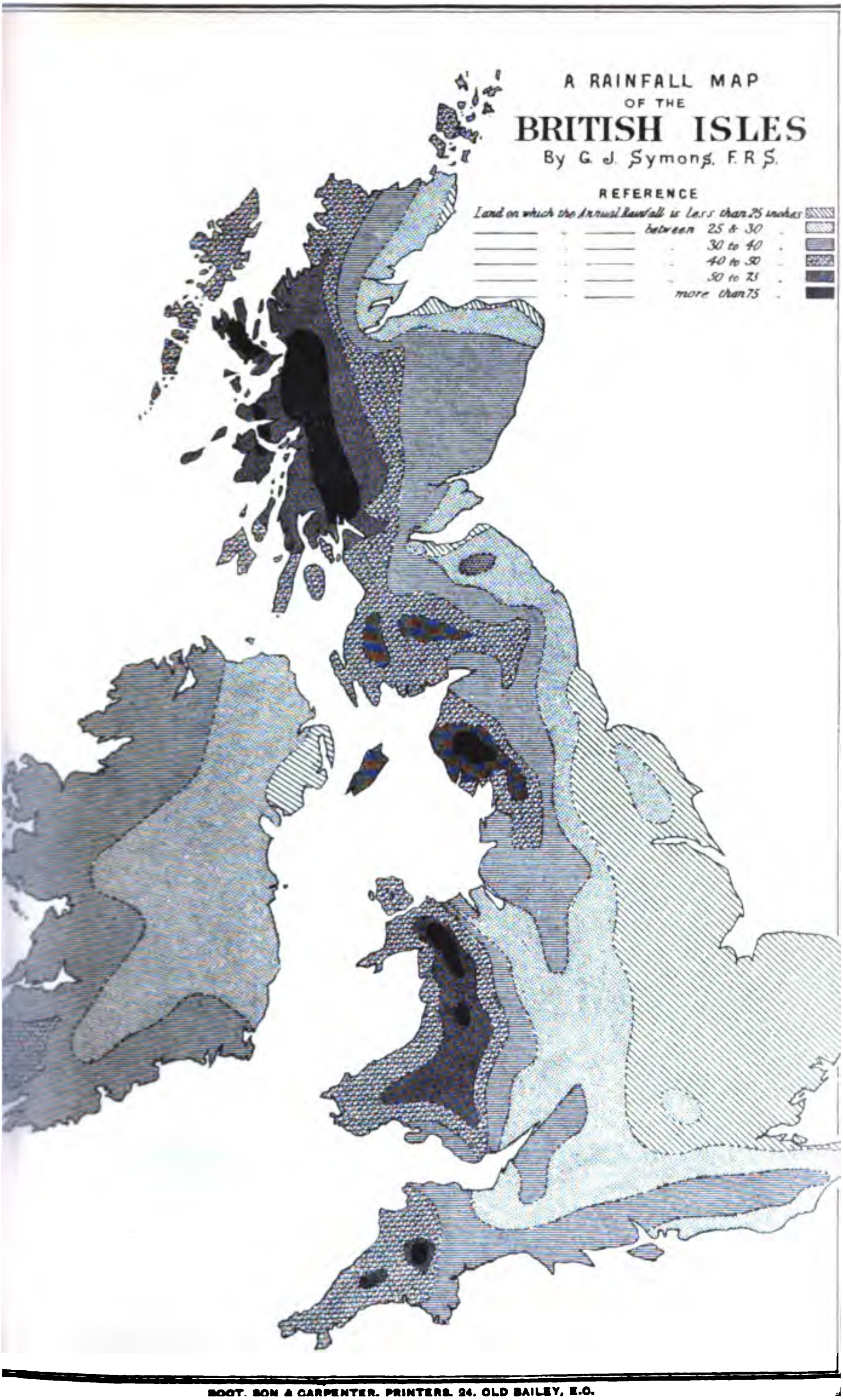


Fig. 6. Beckley's Self-Recording Rain Guage.



BOOT, SON & CARPENTER, PRINTERS, 24, OLD BAILEY, E.C.

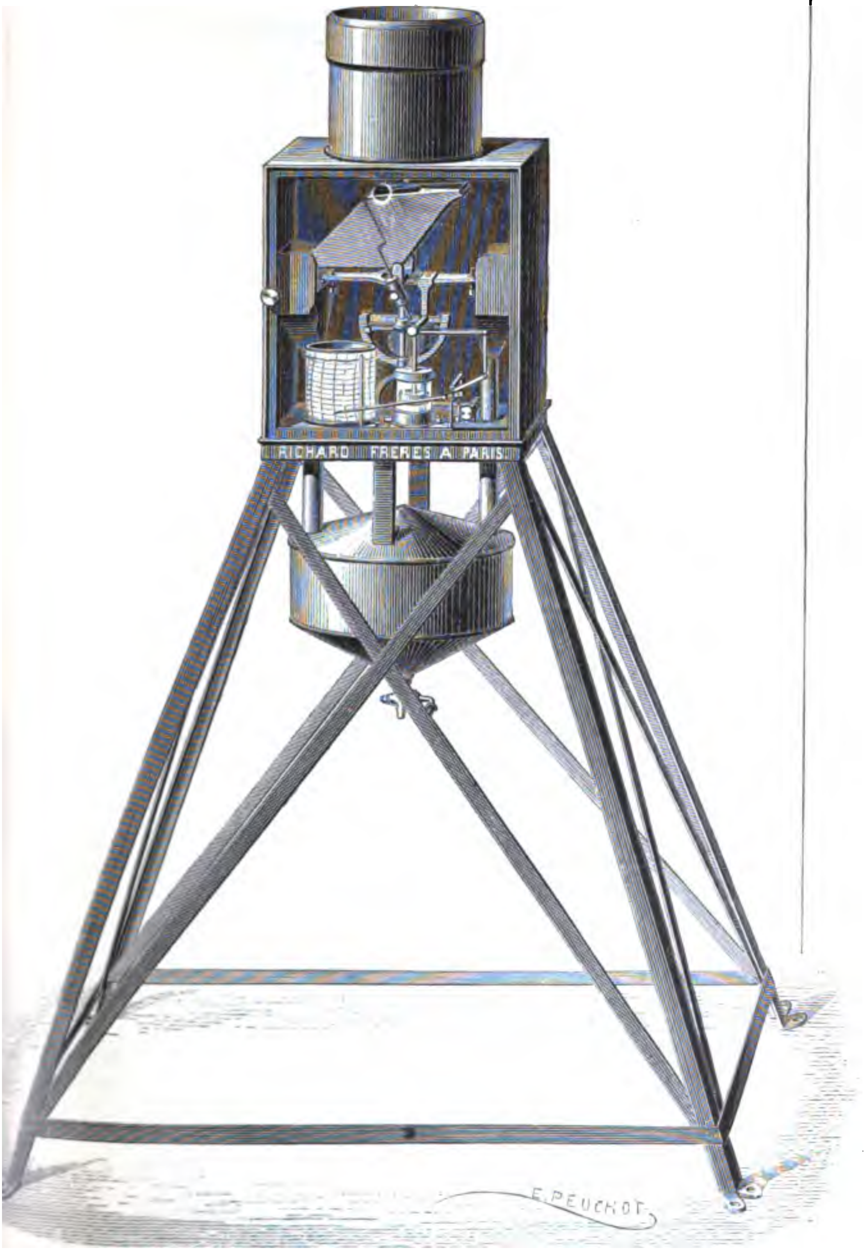


Fig. 7. Richard's Self-Recording Rain Gauge.

pattern adopted by the Meteorological Council. In it the weight of the water displaces mercury. A cup or bottle, A, is supported on a float in a basin of mercury, E, and this float is immersed more and more as the weight in the bottle increases with the rain collected in it. When 0·20 inch of rain has fallen, the vessel is full up to the bend of the syphon, F, the syphon then comes into operation, discharges the water, and the vessel being empty rises to its original level. To the vessel there is attached a pencil, H, which presses against a cylinder. B, rotated by clockwork, D, and thus records the position of the vessel, and consequently the amount of rain.

2nd. The other self-recording rain-gauge is that devised by MM. Richard Frères, of Paris (fig. 7). This consists of a funnel and pipe leading the rain into a tipping bucket, divided into two compartments and placed on a balance. One of these compartments being under the funnel, the rain falls into it and causes the balance to descend; a pen records this motion on the revolving drum. When the pen has reached the top, the tipping bucket reservoir oscillatates, and the water filling the first compartment is emptied into the chamber below. This motion causes the second or empty compartment of the bucket to place itself under the funnel. The filling and emptying of each compartment is alternately and automatically produced, and a rise and a fall of the pen corresponds to each of these double operations.

The following figures give the mean monthly rainfall in London, for the sixty years, 1813—1872, as determined by the late Mr. G. Dines:

	ins.		ins.		ins.
January	1·91	May	2·07	September ...	2·35
February ...	1·50	June	2·01	October	2·74
March	1·52	July	2·32	November ...	2·28
April	1·66	August	2·26	December ...	1·93

Total for the year ... ... 24·55 ins.

The driest month is February, and the wettest month October.

Mr. G. J. Symons, F.R.S., in 1859 began collecting records of rainfall, and in 1860 published his first volume of *British Rainfall*. Under his energy and guidance this has grown into an extensive and valuable organisation, so much so, that for 1892 he was able to publish 2,850 perfect rainfall records.

From an inspection of Mr. Symons's Rainfall Map of the British Isles (page 208) we learn that the average annual rainfall exceeds 40 inches along our western coasts, and that in several districts it exceeds 75 inches, chiefly the west Highlands of Scotland, the English Lake District, and the Snowdonian District of North Wales. Over the eastern part of Ireland and of Scotland, and the south of England, the rainfall is mostly between 30 and 40 inches, while over the eastern counties of England it is less than 25 inches.

At Scathwaite at the head of Borrowdale, Cumberland, rainfall records have been kept for a long series of years, the annual average reaching the large amount of 140 inches, while about half a mile further away on the shoulder of the hill, near Stye Head, the average rainfall is 175 inches.

According to Dr. Buchan there are four very distinct causes of rain, viz., (1) the moist South-westerly winds; (2) rains, often very heavy rains, from the east, extending but a little way inland; (3) the annual fall of temperature from August to January; and (4) those peculiar influences that have their fullest development in the thunder-storms of summer over low-lying extensive plains. He also says, "The moist South-westerly winds acquire their maximum annual predominance in December and January, and as these winds come loaded with the vapour of the Atlantic, the rainfall rises above its monthly mean over nearly the whole of Scotland. Two patches, however, are to a great extent exempt, these being the districts lying on the lee-side of the greatest stretch of mountainous land, viz., to the north-east of the Grampians, and to the east of the Moffat and Lead Hills. Similarly in England during these months the rainfall is considerably below the average over the whole of the dry districts, extending from the Tweed southwards, and bounded on the west by the water-partings of the Mersey and the Severn, and on the south by the bed of the Thames, including the northern slopes of Kent.

"During the time of the great annual fall of temperature from August to January, the greatest excess over the mean monthly rainfall occurs in September and October, when the fall of temperature is most rapid, Westerly winds very prevalent, and heavy rains with Easterly winds, chiefly the Easterly winds of cyclones, of most frequent occurrence. In these months the rainfall reaches the annual maximum over large districts in the east of Scotland, and over all but the whole of England.

"In the northern and the extreme western districts, nearly all thunder-storms occur during the winter months, whereas, few thunder-storms occur in eastern and central districts at this season, but nearly all occur in the summer months, a remark which applies with greatest force to the more extensive level, or comparatively level portions of the country. Now, from the frequent occurrence of thunder-storms and thunder-showers, the annual rainfall of these districts approaches to, and in not a few cases reaches, the annual maximum in the summer months. The local excess begins to show itself in June, is extended in July over the agricultural districts of Scotland and England, which are best suited for the ripening of wheat and barley. In August there is shown a still further development and extension of the summer rains over these and adjoining districts. In this respect the climates of the important agricultural centres resemble the climate of Central Europe, where the rainfall rises to its maximum during the summer months."

Prof. Loomis in his *Contributions to Meteorology*, chapter III, discusses the question of rainfall, and by means of a map shows its distributions over the globe. He points out that among the conditions which contribute to an abundant rainfall are the following: 1. The North-east and South-east Trade Winds, on approaching the belt of calms, which always prevail near the equator, are gradually deflected upward, giving rise to a vertical ascending current within the belt of calms, this ascending current becomes cooled by expansion until its vapour is condensed, causing an abundant fall of rain, and the belt of calms becomes a belt of rain, which from its position is called the equatorial rain belt. 2. A second cause for abundant rainfall is the influence of mountains. When a strong wind meets a mountain it is forced up the side of the mountain; it is thus elevated into a colder region and its vapour is precipitated by the cold of elevation. 3. A third condition favourable to an abundant rainfall is proximity to the ocean, especially when the prevaling wind comes from the ocean. 4. Capes and headlands projecting considerably into the ocean generally show a rainfall greater than interior stations only a few miles distant. 5. The great and non-periodic depressions of the barometer are always accompanied by a considerable fall of rain, and the average tracks of these depressions are marked by an excess of rainfall.

Among the conditions which are unfavourable to rainfall, Prof. Loomis mentions the following: 1. Fresh winds blowing in a nearly uniform direction thoughout the year, such as prevail within a portion of the system of Trade Winds, especially in mid ocean. 2. A second condition which is unfavourable to rainfall is a position on the leeward side of a range of mountains running in a direction nearly at right angles to that of the prevalent wind. 3. When there is a second range of mountains parallel to the first and distant from it not more than 100 or 200 miles, the influence of the last condition is considerably intensified. 4. Although a range of mountains 5,000 or 6,000 feet in elevation is uniformly marked by a great excess of rainfall, if the mountains rise sufficiently high there is a decrease of rainfall near the summit of the range. The maximum effect on rainfall in India is apparently produced at an elevation of about 4,500 feet, and before we reach a height of 10,000 feet the diminution in the rainfall is very decided. 5. Elevated plateaus generally have less rainfall than insulated mountain peaks of an equal elevation. 6. Another condition which is unfavourable to rainfall is extreme dryness of the atmosphere. 7. Another condition which is unfavourable to rainfall is the absence of tracks of barometric depression.

The place which has the heaviest known rainfall in the world is Cherrapunji, a small Indian station situated in the south-west of Assam, on a small plateau forming the summit of one of the spurs of the Khasia hills. The hill on which Cherrapunji is situated rises precipitously about 4,000 feet from the low lands of Cachar and Sylhet, which are barely 100 feet above mean sea level. The South-west monsoon, advancing from the Bay of Bengal, sweeps over these low lands, and meeting the hills, is suddenly deflected upward. Rapid condensation takes place and heavy rain falls. The average annual rainfall at Cherrapunji is about 500 inches, which falls mostly between April and September. In the month of August, 1841, the rainfall amounted to 264 inches. The heaviest rainfall in one day was 40·8 inches on June 14th, 1876.

The extremes in this country appear very insignificant compared with the amounts I have just named, nevertheless, they are often considerable. For instance, on August 6th, 1857, the observer at Scarborough measured 9½ inches, but the rainfall actually exceeded this amount, as the gauge had overflowed. On July 14, 1875, more than 5 inches of rain fell over Monmouthshire. On June 23rd, 1878, Mr. Symons, by his storm rain-gauge, recorded a fall of 3¾ inches in an hour and half. This was during a thunderstorm.

Thunder-storm rains are often very heavy, but are mostly of a local character; they are also occasionally accompanied by hail. On July 8th, 1893, two exceptionally violent thunder and hail-storms occurred in Yorkshire, one at Harrogate, and the other at Richmond. In these storms hail-stones from 2 to 3 inches in diameter fell, and caused great destruction of property.

These hail-stones had several alternate coatings of opaque and clear ice. The coatings were no doubt due to the revolutions accomplished by the hailstones which were probably drawn in towards the vortex of the storm several times.

Of course hail-stones are not often of this size, but usually take the form of little pellets or balls, and consist of compacted ice and snow.

When the aqueous vapour in the air is condensed at a temperature below freezing point it freezes and falls in the crystalline form of snow. Snow crystals are six-pointed stars, and are of great variety. Mr. Glaisher, in the *Report of the Council of the British Meteorological Society* for 1855, gives illustrations of 151 different varieties of snow crystals which he observed between February 8th and March 10th, 1855.

Snow is much less dense than rain. A foot of snow is *roughly* equal to an inch of rain. Snow, however, varies greatly in density; with very dense snow, seven inches may equal one inch of rain, while with very light snow as much as sixteen inches may equal only one inch of rain.

From a long continued series of rainfall records it is readily seen that there is a considerable variation in the annual amounts. The London records of rainfall show that from 1730 to 1750 there was a succession of dry years, and that from 1875 to 1883 there were nine consecutive wet years.

With regard to the limits of fluctuation in the total rainfall, Mr. Symons has arrived at the following results. 1. The wettest year will have a rainfall nearly half as much again as the mean. 2. The driest year will have one-third less than the mean. 3. The driest two consecutive years will each have one-quarter less than the mean. 4. The driest three consecutive years will each have one-fifth less than the mean.

These are the broad general features, and they appear to be applicable to all parts of the country, subject to this slight modification, viz: at wet stations the extremes both of wetness and of dryness are less pronounced than at dry ones.

Mr. Symons said a few weeks ago at the Society of Arts, that thirty years ago he noticed that for many years two rules seemed to have prevailed—(1) that every year ending with 4 had less than the average rainfall, except when that rule collided with the other rule, which was (2) that every twelfth year back from 1860 had more than the average rain.

With regard to the importance of rainfall data, I cannot do better than quote the following remarks made by Sir Frederick Bramwell, F.R.S., at the Society of Arts, on February 28th last. "Where sewage had to be pumped it was most important to know what had to be provided for as an average, and what as a maximum, so that the engineer might know when he would have to give up pumping and have resort to storm overflows. The matter of water supply—it could not be too frequently urged—was, to a great degree, a question of the quantity of rain that could be depended on, what the late Mr. Hawksley used to describe as the average of three consecutive dry years. Last summer, as in 1887, there were very many important towns which were on the verge of a water famine, than which nothing could be more awful. Fortunately, in London, the much abused River Thames provided us with an unfailing supply, which was pronounced by a Royal Commission to be very satisfactory, and he believed it was; at all events, we had no drought. But it was of the greatest necessity that information, such as Mr. Symons had collected for nearly forty years, should be continued."

Dr. Williams in the next lecture will deal with climate in relation to health, so I must not enter upon that subject. I would say, however, in conclusion, that dwellings should never be erected on low ground which is by any means liable to be flooded.

CLIMATE IN RELATION TO HEALTH.

BY C. THEODORE WILLIAMS, M.A., OXON., M.D.,
F.R.C.P., LOND.

Senior Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

Being the fifth of a series of lectures on Meteorology in relation to Hygiene, delivered May 7th, 1894.

MY predecessors in this course of lectures have described to you with great clearness the elements of climate, and it falls to my lot to discuss the relation of these elements to what we are all interested in, viz., the Health of the Community. For Medical Officers of Health the climate of the district ought to be as much studied as its drainage and water supply, though, perhaps, the latter are more under control, but an intimate knowledge of the climate will often clear up ambiguities of results in sickness and mortality statistics, and enable certain precautions to be taken, which may prove of the greatest advantage to those entrusted to their care. Though many bulky volumes have been contributed to the various aspects of Health and Climate, it cannot be said that definite laws have as yet been laid down as to their exact connection, and chiefly because the collected facts on which such rules could be based are still insufficient in number, for only by analysing a very large amount of evidence could satisfactory conclusions be arrived at. Mortality bills and death rates where established have done something, and army and naval medical reports, dealing as they do with large bodies of picked men for the most part of the same nationality, serving in different quarters of the globe, and thus exposed to several climates in succession, have, perhaps, done more still, and probably this is the right direction for future labours. Another difficulty lies in the great change that has been wrought in our knowledge of the etiology and pathology of many of the diseases which we formerly assigned to climate causes. This list was at one time a long one, but has been gradually undergoing reduction. Many diseases such as dysentery and cholera, have been traced to the drinking of impure water, others like yellow fever to endemic and not climatic origin, and in the great majority, a bacterial origin seems highly probable, which has been traced in malarious and in other fevers.

Whilst recognising the germ origin of many of these maladies, we must not forget that while climate is not the actual *vera causa*, it may, and probably does, constitute the principal conditions under which the germs develop, grow, multiply and diffuse themselves, thus becoming of nearly equal importance to the germs. A glance at the geographical distribution of yellow fever or dysentery will show that they only prevail in tropical or subtropical regions, and that they require a certain degree of temperature for this development. Yellow fever is perhaps more controlled by climate than any fever, for it is only found between 32° 42′ N. and 22° 30′ S. latitude. It prevails, as you know, in the West Indies, the Gulf of Mexico, and along the coast of South America, as far south as Buenos Ayres, and has occasionally crossed the Atlantic to the Cape de Verde Islands and Cape Coast Castle on the Coast of Africa, and even on rare occasions has penetrated to the south of Spain and to the shores of the Mediterranean. Its relation to climate is shown by its requiring for its existence and diffusion a temperature of not less than 70° F. together with a certain degree of moisture. It can only prevail during hot and moist seasons, but is extinguished by a heavy rainfall, by cold winds, and by frost or snow. It exists at sea level and is rarely found at any considerable elevation above the sea. It infests sea ports, and as a rule the most crowded and insanitary quarters; it spreads by infection and attacks strangers coming from northern countries in preference to natives. Some races, as the Negroes and Chinese are exempt. Dysentery, again, though doubtless due to bad drinking water, unwholesome food, and imperfect drainage, and thus liable to prevail in temperate countries, is unquestionably far more common and serious in tropical regions, the conditions of heat and moisture favouring the growth of its element of causation.

Before proceeding farther, it may be well to make some arrangement of the subjects of this lecture, and a convenient one seems to be the division of the relation of Health and Disease to Climate, into:—

(1) How far Climate is injurious to health; and
(2) How far it is beneficial to health.

Taking the first, we ask, In what way is climate injurious to health? and, proceeding to the discussion of the elements of climate, we select temperature, and enquire as to the effects of heat and cold on human beings. Now it is often maintained that the human race can live and flourish in any climate, but this can only be accepted under certain limitations. We find that great heat can be borne by individuals, provided the action of the skin be free, and the period of probation be not too long. Tillet [*]states that in the town of La Rochefoucault, at the bakeries, the female assistants as a rule remained ten minutes in the oven at 132° C. (301·6° F.) without much suffering; but far more instructive was the well known example of Messrs. Blagden, Fordyce, Banks, and Solander, who endured a temperature of 260° F. with the small rise of body heat of 2½° F., but if the air became moist and evaporation was hindered, the temperature of the body rose 8° F. In the same oven with the observers, eggs became hard in twenty minutes, a beefsteak was cooked in half an hour, and water boiled.

The presence of excess of moisture in the air seems to check free perspiration and give rise to *insolatio*, or sunstroke, at comparatively moderate temperatures, as the following instance shows. On July 8th, 1853, 1,200 soldiers marched out of the camp of Beverloo, in Belgium, for Hasselt, and in the evening only 500 arrived; nineteen died of sunstroke, and a large number went mad and had to be confined on arrival in the hospital. Nevertheless, the shade temperature that day did not exceed 35° C. (95° F.). Messrs. Mahmoud and Ismael, Egyptian astronomers, told M. Quêtelet that they suffered more from a temperature of 30·7° C. (87° F.) at Brussels than from one of 50° C. (122° F.) at Cairo, owing to the extreme dryness of the air in the latter country.[†]

The evidence from the United States is to the same effect, for while on the Atlantic Coast and in central sections of that country, where the rainfall is considerable and the atmosphere moist, sunstroke is far from uncommon, as General Greely[‡] says, "the inhabitants of the Eastern Coast hear with amazement of temperatures of 118° to 128° F., being tolerated in the dry region of Arizona and South Colorado without harm, and that the ordinary vocations of farm and factory are pursued without inconvenience." This is due to the easy production of perspiration and to the rapid evaporation from the surface of the body. Hence no suffering ensues under this great heat, and sunstroke is unknown.

---

[*] Boudin: Géographie Médicale. [†] Ibid. Vol. I., p. 397.
[‡] American Weather.

The effect of great heat on different organs of the body is as follows: In the case of the lungs it reduces the number of respirations from 16, the standard in temperate climes, to 12·74 in the tropics, accompanied by a slight spirometric increase, but not enough to account for the decreased number of respirations, and so the respiratory function is diminished 8·45 per cent. The water exhaled from the lungs is reduced, and the observations of Parkes and Francis show that the lungs of Europeans dying in India are lighter than the European standard after death, proving that these organs being brought less into physiological activity diminished in size.

The heart's action does not appear to be materially quickened or the pulse rate increased in the tropics, but the powers of digestion are weakened, the appetite fails, and the liver becomes congested and tends either to tissue induration or abscess. The urine is lessened in amount and the urea reduced, possibly from the smaller amount of animal food consumed. The skin acts freely, and its secretion is stated to increase 24 per cent. in the tropics. The nervous system is depressed and sleep is not so sound as in temperate or cold climates.

Protracted residence in hot countries induces further deterioration in Europeans, impairing the functions of digestion, assimilation, and circulation, and hence the power of making healthy tissue: the tint of the skin and the colour of the conjunctivæ, also the expression of premature age, proclaim the length of an European's residence in the tropics. European children demonstrate most forcibly the unfavourable effects of hot climates, and in India it is generally thought desirable to bring them at an early age to a cold climate like that of this country to escape the effect of the tropical heat, and few sights are more pleasing than to see these puny, pallid, skinny, fretful little ones converted by British food and British Meteorology, into fat, blooming, and happy English children.

The most obvious effect, however, of great heat is sunstroke, which occasionally occurs in temperate as well as tropical climates, and though principally due to exposure to the solar rays, according to Sir Joseph Fayrer, happens frequently to people in houses, barracks and tents, and not only when they are exposed to sun heat; it may occur by night as well as by day. The subjects of sunstroke are generally those debilitated by disordered health, dissipation, or over fatigue. According to Fayrer, there are three varieties of sunstroke, each characterized by a certain group of symptoms; the first showing itself in exhaustion and failure of the heart's action; the second in a condition of shock in which the nerve centres, and especially the respiratory nerve centre, becomes implicated, causing rapid failure of respiration and circulation; and the chief feature of the third is intense pyrexia due to vaso-motor paralysis and to the nervous centres being over-stimulated and then exhausted by the action of heat on the body generally. From the first form recovery is frequent, but the second is far more serious, and is generally due to the direct action of the sun's rays on the head and spine. The brain and nerve centres, including the respiratory nerve centre, are overwhelmed by the sudden rise of temperature; respiration and circulation fail, and the heart is found contracted after death. The symptoms of this form are generally those of violent injury to the nerve centres, unconsciousness, cold skin, feeble pulse, and death from rapid failure of respiration and circulation.

The third form, the so-called "heat fever," is an intense state of feverishness, the effect of heat on the nerve centres, and through them on the vaso-motor system, resulting in the raising of the body temperature to as high as 108° or 110° F., or even higher, by heat, solar or artificial. This is the form which comes on at night or in the shade, if the temperature be high, and chiefly affects those exhausted by dissipation, fatigue, or overcrowding. Sir Joseph Fayrer teaches us that all the nerve centres suffer from over-stimulation, followed by exhaustion, there is dyspnœa of a hurried gasping kind, great restlessness, thirst, frequent micturition and pungent heat of skin, which is sometimes dry and sometimes moist. The pulse varies from full and laboured to quick and jerking, the face, head and neck are congested to lividity, the pupils at first contracted, may dilate before death. Delirious convulsions, often epileptiform, coma, relaxation of the sphincters and suppression of urine precedes the end, but not infrequently, partial recovery takes place, to be followed later by relapse and death. The mortality of sunstroke is between 40 and 50 per cent., but of those who recover many are permanently injured, either in brain power or in general health; and we find as a result, impairment of memory, nervous irritability, headache and even epilepsy, partial paraplegia, partial or complete blindness, and extreme intolerance of heat, and especially of the sun's rays.

There are, however, cases of recovery from sun-stroke, especially when contracted in temperate climates, which are either complete or present less serious lesions than the above. In fatal cases, after death, the lungs are found deeply congested, the heart firmly contracted, the venous system gorged, and the body marked by petechiæ. The blood is more fluid than usual and acid in reaction, the globules have less tendency than usual to form rouleaux and are deficient in oxygen. The body, after death, for some time retains a high temperature and the viscera, when first exposed, feel pungently hot, and when incised, drip dark blood. The brain and the membranes are intensely congested and there are sometimes serous effusions into the ventricles or hœmorrhages into the brain substance. The cause of death is generally asphyxia, but apoplexy is occasionally found.

The human frame is able to withstand great extremes of cold when properly clothed and fed to meet the contingency, and above all, if the atmosphere be still. Arctic voyagers have noted extraordinarily low temperatures. Sir John Franklin recorded a temperature of — 58° F. or 90° below the freezing point, and Sir George Back one of — 70° or 102° F. below it. The lowest temperature seems to have been recorded at Werchojansk in Siberia which was — 90° or 122° F. below freezing point, and this cheerless station in the valley of the Iana, owing to its latitude, receives no sunshine during December, and for the rest of the winter the sun is so little above the horizon that the rays have not sufficient power to counteract the intense cold caused by radiation.

If exposure to cold be prolonged and the circulatory and thermogenic powers cannot be maintained, the smaller arteries and capillaries contract and no longer permit the passage of blood corpuscles, and all physiological and chemical changes are arrested. Various parts, including the extremities, becomes starved, and death of certain parts takes place by frostbite or gangrene, commencing first in the toes and fingers.

The effect on the blood, as seen in Drs. Bristowe's and Copeman's experiments, in a case of paroxysmal hœmoglobinuria, show rapid and wholesale destruction of the red globules.

Prolonged exposure to extreme cold gives rise to languor and lowering of the sensibility. The individual loses all power of re-action and sinks to sleep, often to wake no more, as is witnessed on the long marches of troops through the snow, the form of death being coma. Another effect of cold is to produce brain excitement, delirium, incoherency and thickness of speech and symptoms like those of intoxication. Death occurs by syncope or asphyxia. It was remarked by the famous Larrey during the retreat from Moscow, that the troops which endured the cold best were not the northern ones, but the southern, such as the Spaniards, Italians, and southern French, who resisted the cold better and maintained their discipline for a longer period.

A difficult question to answer is how atmospheric humidity influences human life, because in most cases this is largely mixed up with soil humidity. The last has been shown to have considerable effect on the causation of disease, and we know that it is an important factor in the production of consumption, bronchitis, and rheumatism, as the researches of Buchanan, Bowditch, and others have shown. Climates where there is much humidity and a large rainfall, while highly beneficial to vegetation, may act injuriously on human life in two ways; firstly, by raising the level of the subsoil water and thus rendering buildings and surroundings damp. In this way are promoted rheumatism, bronchitis, and possibly phthisis; and secondly, by obscuring or diminishing the wholesome effects of the sun's rays, for, while undoubtedly the tints of British complexions, as contrasted with those of continental or southern nations, owe much to the moist vaporous envelope through which the sun has to shine in our Isles, yet it must be remembered that a certain percentage of sunshine is requisite for the full development of the process of sanguification, and recent observations show that in misty districts with a large rainfall like Dartmoor, the prevalent disease is anæmia. Sunshine has been demonstrated to exercise a bactericidal effect on pathogenic and other organisms and to hinder the evolution of the tubercle bacillus.

Among the elements of climate which affect health or disease is *wind*, and it may be safely asserted that as a rule it exercises a beneficial influence in removing exhalations of all kinds, producing evaporation from the body surface and in promoting the complete ventilation of the atmosphere. Calmness and stillness of air is favourable to bacterial growth and multiplication, whereas a strong northerly or north-easterly wind is generally the means of sweeping away the residue of an epidemic which may have been lurking for some time in a neighbourhood. So, though wind blowing from a hot or from a cold quarter may prove an unwelcome guest to the region visited, yet on the whole it is the means of equalizing climate, and of distributing moisture by aerial circulation.

Coming now to diseases prevailing in hot climates and apparently dependent for such prevalence on the special conditions of those climates, it will be noted that dysentery and its frequent companion, which is also not rarely its sequela, liver disease, form part of the group. A map of the geographical distribution of these diseases shows that liver disease is confined to hot countries and does not largely overstep the limits of the tropics, whereas dysentery has a somewhat wide range, but prevails with far greater virulence in the tropics than in subtropical and temperate regions. Fayrer shows that at Calcutta the deaths from dysentery and diarrhœa amounted in one year to 1,516, and that the mortality from these causes was highest in January (243 deaths), and lowest in May (85 deaths).

Dysentery is often attributable to drinking impure water and to insanitary surroundings, as well as to malaria. Some cases appear to arise from sudden meteorological changes, such as from hot to cold and from dry to wet weather. All the causation of this disease seems to be largely governed by the influence of climate, and hence its greater prevalence in hot climates compared with cold.

Liver disease in India was attributed by the late Professor Parkes to errors of diet on the part of Europeans in a hot country, and probably there is truth in this, but it can hardly account for the extensive mortality among Hindoos, Mahommedans, and other natives from this cause.

But of the many diseases linked with climate, there is one which perhaps above all others can be closely associated with air and soil, both of which conditions determine its prevalence and spread. I allude to malaria and malarious fevers which prevail in all quarters of the globe, but under tropical conditions becomes far more virulent and enduring. In northern and temperate climates like our own, it shows itself in various affections of the nervous system such as migraine or megrim, and other forms of neurosis, in enlarged spleen and liver, in hæmaturia and hœmoglobinuria, and lastly, in that condition of the constitution which is termed "malarious cachexia," characterized by the state of the conjunctivæ by the greyish-yellow tint of the skin, and by absence of healthy colour and lack of energy. Besides these forms, we have occasional though rare examples of intermittent fever. At one time, before the extensive operations of subsoil drainage, ague was comparatively common in Lincolnshire, Essex, and parts of Kent, but now cases are rare and often only appear after a wet season. According to a table of admissions for malarial fever furnished by the London Hospital to Sir Joseph Fayrer, and which extend over a period of 110 years, from 1770 to 1880, whereas in 1781, out of 1,781 patients admitted into the hospital, sixty were for malarial fever, in 1880, out of a total of 6,312 admissions, fourteen were for malarious fever, and in many years the proportion was still smaller. This is a very good example of the diminution of malarial disease in the United Kingdom generally, since the time when we lost kings and nobles from ague fits. As a contrast, however, Sir Joseph Fayrer teaches us that in Ceylon in ten years, 94,821 persons died of ague and remittent fever, and in the Madras Presidency in one year, viz., 1880, the deaths from these causes were 209,940, increasing during a famine year (1877) to 469,241. The monthly mortality varied from 14,930 in June, 1880, to 23,969 in January, and this appears to be greater in winter than in summer, increasing apparently with the lowering of the temperature after the extreme heat. Europeans are thought to be more liable to malarial fever than natives, but this is not altogether proved, for Waring shows by a comparison of the relative prevalence of fever in the European and native troops of the Madras army for ten years (1829 to 1838), that while the percentage of admissions from fever was for Europeans, 12·8, for natives it was 16·7, and the mortality for Europeans was ·12 against ·24 for natives. Malarious fever prevails extensively in tropical Africa, but here natives do not seem as liable as Europeans, in fact, negroes were at one time held to be exempt; but Surgeon Parke proved that natives of Western and Central Alfrica, though they might be acclimated at home, if they removed to another part of the country, lost their immunity and were as liable to contract malarial fevers as Europeans. Therefore it will be seen that race does not ensure protection.

The close connection of malaria with soil is shown in various ways. If the sun's rays are prevented from reaching the soil by the interposition of paving as has been done in many parts of the city of Rome, malaria ceases; and if a marsh be flooded from the sea, and thus a layer of salt water covers the soil, malarious influences disappear. On the other hand, it is promoted by the rapid drying up of marshes, beds of rivers and streams, and especially by the breaking up of such soil, when fresh surfaces are exposed to the sun's influence. According to Parkes the special soils which appear to promote malaria are the following:—(1) Alluvial soils, old estuaries and deltas. (2) Sands, if there be impermeable clay or marly subsoil, and old water courses. (3) The lower parts of chalk, if there be a subsoil of clay or gault. (4) Weathered granite trap rocks, if vegetable matter has become intermixed. (5) Rich vegetable soils at the foot of hills. Fayrer holds that subsoil water or damp is the essential condition of malaria, and especially if the subsoil be impregnated with a certain amount of stagnant moisture, and this is probably present in many of those localities in which the appearance of malaria is so difficult of explanation.

Malaria appears to be at its worst in the drying up season after rains but during the rains it is less severe. Whilst turning up new soil generally increases the danger of malaria, draining and cropping the same soil afterwards diminishes it.

In the South of Europe deltas of rivers and the low lying districts with a certain amount of marsh, are the common foci of malaria. Altitude exercises some protecting influence, and in the malarious districts in South Italy, the villages are built on the hills for this reason, but it has been shown that wind may carry the malarial poison up the sides of mountains and indeed over their tops. Surgeon Parke mentions having met with it in Equatorial Africa on a dry plain 10,000 feet in height, so that elevation must not be reckoned on as giving complete protection. There seems to be some relation to rainfall, as in tropical countries it appears to prevail in districts with a large rainfall, as in the Indian Terai, possibly on account of the constant presence of subsoil water.

The cause of malaria is now held by competent authorities to be a protozoon or vegetable micro-organism, inhabiting the blood of man and of some of the lower animals. It was discovered by Laveran in 1880 in human blood at Algiers. Klebs and Tommasi Crudeli had previously succeeded in isolating the Bacillus malariæ from the low lying atmosphere over marshes and from the soil, with which they inoculated rabbits, with the result of producing a malarial paroxysm with enlargement of the spleen; but Laveran's interesting researches, confirmed by those of Marchiafava, Vandyke Carter, Councilman, Osler, and others, appear to point to a very close connection between the *plasmodium*, as he calls it, and the ague attacks, and he is inclined to think that the malarial germ is a single but polymorphic organism, and that the type of the fever depends in part on the particular form of germ, and, in part, on the condition of the patient and his tolerance of the organism. Laveran describes four forms of the protozoon—(1) amœboid spherical bodies with nuclei; (2) crescentic shapes with nuclei; (3) rosettes; and (4) flagellate bodies. These last are very delicate, and are found in fresh blood and difficult to see, except when the blood is in motion. They may be contained in the blood plasma, or in the substance of the red corpuscles.

In acute malarial fever the amœboid bodies are seen either occupying, or adhering to, a certain number of red globules, at whose expense they appear to develop, deriving their pigment from them. During the paroxysm they undergo segmentation, the resulting segments varying greatly in size, and being colourless and transparent. According to Laveran the crescentic forms of the germ are common in the blood of the quartan, and irregular types of disease, and in malarial cachexia. They are larger in diameter than red globules, and have occasionally fine lines forming the ends of their crescents. They are said to be more common in autumn. Quinine is found to exercise some

---

[*] Paludism, translated by J. W. Martin, M.D., New Sydenham Society, 1893.

effect on the amœboid form of the germ, but less on the crescentic. The leucocytes are believed to antagonize the parasites, and spontaneous recovery from malarial fever is attributed to their destructive influence either on the germs or their toxines. Golgi thinks that there are several distinct parasites which are developed periodically, and would account for the paroxysmal character of the symptoms of ague, by a correspondence with the various stages of development of the germs. He finds a plasmodium in the blood of patients several hours before the onset of the fever about one-fourth the size of a red globule, which gradually occupies the red discs at the expense of their substance, which it converts into small rods and granules. The plasmodium waxes and the red corpuscle wanes until it is scarcely visible. Finally the pigment of the blood corpuscle is gradually devoured by the parasite plasmodium, which absorbs the pigment granules into its centre, and shows a marked tendency to subdivide. Radiating lines mark off its substance into separate masses. New cells are formed, which attack other red discs and destroy these in turn.

In tertian ague the organism completes its development in two days, and has a more distinct outline than in quartan ague. In quartan ague the outline is coarser, the pigment rods and granules are thicker, and the evolution takes three days. Malarial fever has been transmitted from patient to patient by inoculation with the blood. It cannot be inoculated into birds. Malarious poison may enter the body either through inhalation, or in liquids swallowed.

Unfortunately we have no time to discuss other diseases produced or aggravated through the action of climates, but must now pass on to consider the second part of our subject, viz., how far climate is beneficial to health. Doubtless race is largely mixed up with this question, and the climate which would benefit a European might have the reverse effect on a negro or Polynesian. The motive of some of the great migrations of nations and races may have been partly due to the search after a better climate, but in many instances it was clearly for the sake of gain or of fertility of soil, or through the compulsion of a stronger race, and the climate of the land in which the wanderers settled down was not invariably a desirable one. If we judge countries by the vigour of their races, we shall unquestionably award the prize to the northern and especially to mountainous districts, where the severe climate and difficulties of subsistence stimulate the inhabitants to great exertions, and promote both physical and moral development. Two races have for centuries continued their migrations, the Gypsies and the Jews, and about the latter there are several curious facts.

As a rule they can hardly be said to have a settled home, but have spread to all parts of the globe, and, though an oriental race, have managed to thrive and multiply and preserve their characteristics in all climes, and in spite of opposing circumstances. This can hardly be said of any other people. The Anglo-Saxon race flourishes to a wonderful degree in temperate regions and forms prosperous colonies, but in tropical countries like India it neither thrives nor multiplies, and has to be replenished from time to time from the parent country.

The climates which a modern physician utilizes in the treatment of disease and in the promotion of health are various, but the principal groups now recommended may be summed up as (1) The dry, warm, or desert climate; (2) Marine climates of all kinds; and (3) Mountain climates. The first group is exemplified by the climate of the deserts which are to be found in Africa, Asia, North America, and Australia. Taking the Egyptian desert as a type, we find the principal qualities are: firstly, great warmth from the sun's rays, and corresponding extremes of temperature from radiation; a maximum of 111° F. and a minimum at night of 35° F. are noted, with an enormous daily range. Secondly, dryness of atmosphere as shown in the small rainfall which is almost nil in Upper Egypt, and small at Cairo (1·22 inches) with a difference between the wet and dry bulbs amounting often to 24°F. The dryness is also evidenced by the mummies which remain unchanged in the desert for centuries. Thirdly, great atmospheric purity shown by the entire absence of carbonic acid in desert air given by Prince Zagiell's experiments, and by its asepticity. This is proved by putrefaction being checked; meat instead of undergoing decomposition becomes dry and mummified, and wounds heal rapidly. Fourthly, occasional hot winds, such as the Khamsin or S.E. wind which shrivels up vegetation, and for the time inducing languor both in Europeans and natives. This dry climate in winter exercises a most benefical influence on many forms of phthisis, on diseases the offspring of damp, such as rheumatism and bronchitis, on chronic pneumonia and asthma, and owing to the coolness of the nights by inducing sleep, it is of great service in many forms of nerve disease.

Our second group is a very large one, and includes all climates characterized by the predominence of the marine element, and partaking of it in different degrees, combined with varying amounts of warmth and moisture. It comprises the climate of sea voyages to many parts of the world; that of coasts washed by warm ocean currents, like our British South coast places and Southern California; also climates with temperatures equalized by tropical seas, such as Madeira and the

Canaries; or again, where the stimulating warm influence is the chief feature, as in the Mediterranean health stations. I cannot profess to discuss these varieties of marine climates here, but must refer you to my recently published work on Aero-therapeutics* for fuller information on climates and their results, so will only briefly touch on the characteristics of the climate of sea voyages. These are equality of day and night temperature, a large amount of humidity, and some degree of asepticity. The typical sea voyage, that from England to Australia round the Cape of Good Hope, when undertaken in October or November, gives a range of temperature between 47° and 82° F., an average relative humidity of 82 per cent., and about twenty rainy days in three months. The most beneficial period of the voyage is that spent in temperate climates, and the least beneficial that in the tropics; the effect of which on sailors has been shown by Rattray to be injurious, resulting in considerable loss of weight, this being intensified if a salt diet and muscular exertion be added. According to him, in the tropics, the urine diminished 42 to 59½ per cent., and the perspiration increased from 8½ to 30 per cent. There was a diminution of 4½ per cent. of the fluid exhaled by the lungs and a slight increase in that excreted by the bowels. The kidneys appear to be the chief eliminators of surplus water, but the action of the skin is most marked in the tropics and that of the kidneys in temperate climates.

Invalids, being well fed and not liable to great physical exertion, do better than sailors in tropical seas; but even among them, as seen in the Red Sea, the results are sometimes disastrous, and the passage from this sea to the Mediterranean and to a much cooler atmosphere, has produced albuminuria.

The great benefit of sea voyages is the entire rest of mind and body, the promotion of sleep of the soundest kind, the abundance of fresh air without fatigue, and the astonishing increase of appetite and gain of weight, which last is rarely equalled on shore.

Sea voyages seem most to benefit chronic diseases, such as chronic pleurisy and empyema and bronchitis; all forms of scrofula and struma; cases of limited excavation in phthisis, hœmorrhagic phthisis, and various neuroses, especially cases of insomnia.

The third group is that of mountain climates, the home of hardy, though necessarily scanty populations, which enjoy a remarkable immunity from many forms of disease. When contrasted with lowlanders, the highlanders are generally taller, with broader and deeper thoraces, and greater powers of endurance in walking; and this is true of all mountain races, be they natives of the Himalayas, Andean Indians, Swiss or Tyrolean guides, or Scotch Highlanders.

---

* "Aero-therapeutics, or the Treatment of Lung Diseases by Climate Macmillan & Co.

The mountain ranges chiefly utilized for climatic purposes are the Alps, the Rocky Mountains, the Andes, the Himalayas, the Nilghiris and the Zwartebergen, Nieuwveld and the Drakensberg in the Cape Colony. These ranges, differing as they do, in altitude, latitude, and meteorology, present certain climatic characteristics, which are for the most part absent in lowland districts, viz., (1) diminished barometric pressure and consequent rarefaction of the atmosphere; (2) diathermancy of the air, owing to the increased facility with which the sun's rays are transmitted through an attenuated medium, having, according to Dr. Denison, an increase in the difference between the sun and shade temperatures of 1° F. for every rise of 235 feet; (3) dryness of air, from a low temperature causing absence of fog and mist; and (4) asepticity and freedom from organic germs.

The physiological effects of mountain climates, as shown on healthy or sick persons ascending from the lowlands, are briefly the following:—The skin is tanned by the solar rays, and especially by the ultra violet rays (Bowles), the circulation is at first quickened, and the heart's impulse increased in power, but at the end of six or eight weeks the pulse rate becomes less rapid, and it eventually is slower than normal. Respiration is at first quickened, but after about the same time it becomes slower, and also falls below normal, the inspirations being deeper, and the expirations (Ruedi) more complete. The quickening of the circulation and respiration is accompanied by thirst, by a reduction in the blood pressure, and in the urea excreted by the kidneys, but more carbonic acid (Marcet) and water are eliminated from the lungs as might be expected from more oxygen being inhaled. Later on, when acclimatization is complete, the normal amount of urea is again excreted, and the blood pressure increases.

Coincidently with the slowing of the respiration, there is an extension of the thorax in several directions, causing an increase of the circumference measurements of from 1 to 3 inches, with increased mobility of the chest walls.

All this points to greater physiological activity of the pulmonary organs from the necessities of a rarefied atmosphere leading to greater development, and it must be noted that all mountain races have large and deep chests, and are able to march great distances and to climb mountains with comparative ease. The effect of high altitude climates on healthy persons is excellent, and on most forms of phthisis it has been shown by my statistics to far surpass in results any other set of climate agents. At the same time this is a two-edged weapon, and in many cases of disease, such as those of the heart, liver, brain, and in emphysema and in bronchitis, as well as in the case of the aged and of those with weakly constitutions, it must be avoided as most harmful. Finally, the mountains are highly to be recommended as playgrounds for the mentally tired workers and for the young, who can rest their brains and work their muscles, and by inhaling pure aseptic air, may renew health and vigour, and return to their duties refreshed as well as recreated.

FOG, CLOUD, AND SUNSHINE.

By F. GASTER, F.R.Met.Soc.

Being the Sixth of a series of lectures on Meteorology in relation to Hygiene. Delivered May 10th, 1894.

It must be evident, to all who consider the matter carefully, that either of the subjects proposed for this lecture—Fog, Cloud, or Sunshine—would furnish abundant material sufficient for a lecture, without the aid of the other two; so that if those whom I address find many points neglected on which they would gladly have heard something, I trust that they will understand that the question of "time" is the only one which prevents me from dealing with them more fully than I would otherwise have done. I must ask my hearers, therefore, to leave to me the selection of the points on which I may touch, and also for their indulgence while I deal with them as fully as I can.

To begin—Fog, as we are about to consider it, is an aggregation in the lower stratum of the atmosphere, of myriads of minute particles of water, now pretty well known as "water dust." Its most conspicuous effect is the obstruction of rays of light through the atmosphere—the obstruction varying in intensity with the fog's density. It appears sometimes in a "wet" condition, moistening to a considerable extent bodies exposed to its influence, producing the sensation of exceedingly minute rain drops on the face, &c., and dropping from the boughs of trees as though they had been rained on; at other times it is in a comparatively dry condition—not damping, or scarcely damping, objects exposed to it, not producing the sensation of minute rain drops falling on the face, and not dropping from trees, &c., as the wetter fogs do. In large towns and cities a very dry modification is often observed, the causes of which are mainly local, but in all true fogs the basis of the phenomenon is the water dust extracted from the atmosphere, or introduced into it by some moist object.

Fog may be formed in various ways, *e.g.*, (1) by the contact of two air currents, the temperature of which when mingled is rather lower than that of their dew-point; (2) by a damp air current passing over some cold object (such as a cold river), when the colder object condenses into a shallow fog the vapour in the lower part of the air; (3) by the advent of a cold air current over relatively warm water, when the water discharges into the air vapour, which at its existing temperature the air is unable to hold in suspension, and which consequently assumes the form of fog. The most common way is by the rapid cooling of the earth's surface by the radiation of its heat into space during long, clear, quiet, nights, when the temperature falls below the dew-point; the air being still, its moisture is thus changed into fog, which appears first at the ground and gradually spreads upwards. Valleys are excellent localities in which this operation may be carried on, the air being kept very still by the surrounding hills, while the radiation of heat goes on interruptedly, both from the valley and the hill sides.

Now it has been shown by Dr. Aitken that an excess of vapour may exist in any given space, and appear in the form of heavy dew without the appearance of fog, provided the atmosphere be entirely free from particles of dust or smoke, but that the introduction of extremely minute dust at once brings about its condensation in the form of fog—the dust particles forming a series of nuclei, round which the water can collect. We might consequently expect that the smoke produced in large towns would turn them into positions peculiarly favourable for the development of fog, when the atmospheric conditions already referred to have been established. This is found to occur, and, as many or most, of our largest towns lie in river valleys, they are completely adapted to become fog-producing centres, and are for other reasons also, the localities in which the phenomenon is exhibited in its worst aspects. The mere term "London Fog" has earned for itself a most unenviable reputation, and most of our large cities are somewhat similarly notorious, but yield to the Metropolis as regards both frequency and intensity on account of its enormous size.

Let us now reconsider what are the atmospheric conditions favourable for the development of fog. They are still calm air, low temperature, a clear sky, and (some add) high barometric pressure. The last named, however, may probably be only incidentally present when the other features are secured, and take no active part in the fog-making. Of the two great weather systems which present themselves to us in nature (the Cyclonic and Anticyclonic) it is the latter which brings to us the requisite conditions, and this chiefly during the colder half of the year. In this system the pressure is high and uniform, the temperature low, the wind light or calm, and the sky clear. No sooner are such conditions established than the fog begins to appear—first in the large cities and towns, then in the lower parts of the country, and the longer the anticyclonic conditions last, the worse the fog becomes in the cities and towns which it covers. The chief qualities of dry (anticyclonic) fogs in towns are well known; they obstruct light to such an extent that on some occasions an object at from three to five feet distant is invisible even in daytime; they invade public buildings and private dwellings, and are apparently uninfluenced by the presence of even a bright fire, or high temperature in the room;

(I have known a room full of fog with the temperature artificially raised to 70° F.) Dry fogs also obstruct the free radiation of heat, so that while the sun's heat rays do not reach us from above, the warmth generated by the thousands of fires in the towns cannot escape freely into the higher parts of the atmosphere; the result is that during fogs the temperature within towns is often very many degrees higher than that registered in the suburbs where the sky is clear. Nor is this all, for fogs prevent the free escape of sulphurous and other vapours, emanating from chimneys, and putrescent matter from other sources, to the serious injury of the inhabitants, and of plants exposed to their influence. London and other large towns are at times for days together in a state of complete or nearly complete darkness, and often the air becomes so charged with soot, sulphur, and various other injurious matters, that the mucous membranes are affected to a serious extent, and people suffering from delicate membranes succumb in large numbers; others suffer seriously, but not fatally, and none fully escape discomfort. In the open country these conditions are not nearly so prevalent, and even within the urban districts, dwellers in the thinly populated parts suffer less than those in parts where the population is more dense and the position more central. It is the domestic fires which contribute the lion's share of the poisonous ingredients, and it has not yet been satisfactorily *proved* that the burning of so-called "smokeless" coal would do very much to ameliorate the evil.

The following Tables are compiled from Values given by the "Manchester Field-Naturalists and Archæologists' Society":—

TABLE 1.

Showing the maximum and minimum amounts of Sulphur found in the air at the Town Hall, Manchester, during each of the months, September, 1891 to August, 1892. [Expressed in milligrammes of SO_3 per 100 cubic ft. of air.]

Months.	Max.	Min.	Means.
1891. September	2·7	1·0	2·0
October	6·8	1·2	3·4
November	14·0	2·9	6·2
December	20·5	3·4	10·1
1892. January	12·7	4·7	9·1
February	8·9	5·6	7·1
March	26·7	7·6	12·7
April	18·5	5·1	10·3
May	4·1	2·7	3·4
June	4·4	1·3	2·6
July	2·4	1·0	1·7
August	4·4	3·0	3·9
Means—all Months	10·5	3·3	9·3 Nov. to April. 2·8 in the other 6 months.

Table 2.

Showing from observations made at Owens College, Manchester, the amount of organic matter suspended in the air on the dates named. [Values are given according to the number of milligrammes of oxygen required to oxidize the organic matter in 1,000 cubic feet of air.]

Dates.	A*	B*	C*	Totals.	Weather.
1891. Sept. 16...	0·7	Nil.	Nil.	0 7	Dull.
Oct. 20...	0·8	0·4	1·3	2·5	Clear.
" 22...	3·0	3·2	0·8	7·0	Rather hazy.
" 24...	7·3	5·2	1·0	13·5	Light fog.
Nov. 6...	6·0	6·5	1·7	14·2	Do.
Dec. 21	14·6	5·2	8·2	28·0	Dense fog.
" 22	7·5	16·9	5·3	29·7	
" 23	17·1	14·3	9·3	40·7	
1892. July 30...	3·0	2·8	1·3	7·1	Gloomy.
Sept. 6—8	2·5	1·3	0·4	4·4	Hazy.

* A=Highly putrescible matter; B=Less putrescible matter; C=Soot.

It is impossible in the limits here available to discuss these Tables fully; but it may be pointed out that the figures in Table 1 show, that in the months most subject to fog the objectionable inorganic matter discovered in the air increases rapidly. Table 2 shows that the putrescible matter also present is in much larger quantities in foggy than in clear weather.

The next Table points to the results of these conditions as they make themselves felt in the death-rate from Pulmonary diseases only. The figures represent the annual death-rate per 100,000 of the population, in the different quarters of the years named.

Table 3.

Dates.	Manchester.		Glasgow.	
	Least Populated Area.	Ancoats. (Densely Populated.)	Least Populated.	Densely Populated.
1890. 4th Quarter	132	430	For one	Year.
1891. 1st "	163	407		
2nd "	171	490		
3rd "	68	417	870	1600
4th "	132	340		
1892. 1st "	139	360		
2nd "	101	257		
3rd "	57	209		

These Tables referring to Manchester have been selected because we hear so much about London and its fogs, that many people seem to think that other large towns escape.

I must pass on, however, to consider for a moment the more humid kind of fogs. These too obstruct the passage of rays of light through the atmosphere, but beyond this they and the drier fogs appear to have no features in common. Their effect on the parts of the body exposed to them is, as before stated, almost like exceedingly minute droplets of rain, and during their continuance the water pours down from boughs of trees just as it does when rain is falling. Their temperature is decidedly higher than that of the drier fogs we have just been considering, they do not irritate the mucous membranes, but are liable to cause severe colds in those who are unduly exposed to them. Although they often appear at times when the general distribution of pressure is high and anticyclonic, yet it is commonly found that an exceedingly faint cyclonic circulation has been set up in the immediate locality where they are developed, and it is not uncommon to find this feature at the end of a long period of dry fog, heralding the breaking up of the conditions which have produced it. The matter is now under discussion by Mr. R. H. Scott, and it will therefore be only right for me to leave it for the present without further remark. The next Table (4) is from a paper read by Mr. Scott before the Royal Meteorological Society; it shows the number of foggy days reported at certain stations in the fifteen years 1876—90, and is the most complete record available.

TABLE 4.

MONTHLY TOTALS OF FOGS, 1876—1890.

STATION.	Jan.	Feb.	Mar.	April	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Sumburgh Head	5	1	9	8	23	30	44	47	18	11	5	1
Stornoway	3	6	8	6	6	9	11	7	10	4	5	4
Wick	14	5	6	17	39	36	32	40	17	10	5	3
Nairn	6	1	5	7	6	16	7	8	14	2	3	2
Aberdeen	10	6	9	10	11	16	15	11	10	5	4	1
Leith	36	33	23	14	10	8	9	10	34	47	69	52
North Shields	45	33	33	21	29	21	9	28	54	54	49	68
York	73	32	16	8	4	0	0	8	23	51	62	69
Nottingham	57	34	34	9	9	4	2	18	52	72	47	62
Ardrossan	97	80	61	54	28	31	14	39	62	82	69	96
Donaghadee	10	2	3	3	2	14	13	8	17	11	8	2
Liverpool (Bidston)	50	34	22	8	5	7	4	16	22	45	45	51
Holyhead	35	37	24	23	18	19	17	16	18	23	9	23
Valencia	9	9	2	7	4	1	3	12	8	15	6	5
Roche's Point	24	14	17	15	17	37	22	30	23	15	16	25
Pembroke (St. Ann's Head)	45	40	41	25	41	55	54	38	41	15	25	26
Scilly	38	35	33	24	48	77	64	66	48	17	23	23
Hurst Castle	44	29	34	18	13	22	9	13	29	18	19	40
Dover	36	38	29	25	16	30	15	19	6	27	21	48
London	131	84	73	32	16	7	7	10	82	132	117	143
Oxford	103	58	42	15	3	1	2	10	61	87	101	116
Cambridge	18	10	4	3	1	0	0	3	4	13	14	26
Yarmouth	144	97	59	42	24	16	6	12	32	79	97	134
Totals	1033	718	587	394	373	457	359	469	685	835	819	1020

We cannot help seeing here, that in the colder months the E. and S.E. stations are much more foggy than those in the W. and N.W., as the former are influenced more by the Continental anticyclones than the latter; but in the summer months the W. and S.W. stations have the largest number, under the influence of the Atlantic anticyclones which then approach our S.W. coast somewhat closely.

We come now to the question of clouds. Fog may be looked upon as raw material, clouds are the fully developed, or "manufactured" articles. That there is a vital difference between fogs and clouds I am quite satisfied, but this is hardly the place, even if there were the time, to enlarge on this part of the subject. It may nevertheless be noted that it is only while the fog lies in contact with the earth that it is sheet-like in form, that as soon as it "lifts" it assumes a form (when it assumes any definite form at all) which approximates to the cumulus rather than the stratus form, and that frequently it disappears speedily by evaporation, much the same as the steam from the funnel of a locomotive engine disappears even when the air is fairly damp.

Let us proceed to consider the two main classes of cloud as they appear in nature, and see what we can find of interest and value in them. Starting first with those of the "Cumulus" type, we find that they consist of a heap of water particles, piled up like masses of cotton wool, rising from a horizontal base. The variations in its colour (white, dark, or silver edged) depend wholly on their position with regard to the Sun or Moon—the darker portions being those which are thrown into shade by its other parts, or by some other cloud coming between them and the source of light, while the lighter and often brilliant portions are those which reflect the rays of the sun or let these rays pass through from behind. The upper edges of the true *cumuli* are rounded and sharply defined, but the base is looser and more horizontal. These clouds may be small, and appear in detached portions drifting over the sky, or they may be piled in vast masses to a great height, and in this form are best observed when hanging far away on the horizon, in enormous heaps, which sailors say indicates a shift of the wind to the quarter in which the bank is observed. To such banks the term "piled cumuli" has sometimes been applied. On other occasions, and notably in thundery weather, portions of these banks rise up like enormous turrets, above the general mass, and change their form rapidly; and at all times the cumuli form objects of great beauty, and reflect the rays of the light from the Sun and Moon with ever varying effect. As a rule the smaller cumuli are fine weather clouds, but it often happens that the larger masses undergo a change in their upper parts which assume a *cirriform* structure; and when this occurs, or when the upper portion of the cloud unites itself with a layer of stratus cloud in its neighbourhood, the cumulus becomes changed into the "cumulo stratus," of Luke Howard. It has recently become usual to call this variety "cumulo nimbus," as heavy passing showers fall from it, accompanied frequently by thunder and lightning. The illustration presented on the screen leads to the conclusion that a thunder shower was in progress at the time the photograph was taken, as some high electric strati are seen above the cumulus bank, and the "breaking off" of the upper surface of the cumulus is of a very decided character. Should this process of disintegration be continued, the cumulus is steadily reduced in size, becomes *cirriform* all round, and in no way resembles the cloud in its earlier stages; inexperienced observers have in fact been known to call such clouds "low cirrus." The bases of cumuli are often observed at about 3,000 feet above the earth's surface, while their summits rise many thousands of feet upwards and pierce the strata of higher cloud-forms, yet to be described. More commonly however, the bases of the clouds appear at a higher level, and it may be taken as a rule that the higher the altitude of the base, the smaller is the vertical measurement, or thickness, of the cloud, so that it is at last hard to distinguish between such clouds and certain others of the *stratus* type; in this condition the term "*strato-cumulus*" is now commonly applied to the form. The above are the main characteristics of the cumuli.

We have now to consider that class of cloud whose distinctive feature is that they assume the form of sheets, or layers, in contradistinction to the massed or heaped form of the cumuli. Sheet-clouds are known under the general term of *Stratus*, and appear at various elevations from a few, to many thousands of, feet. Many observers include even ground fog among them; even if this were correct the fogs have already been dealt with at great length in this lecture and time forbids our dealing with them any further. There are, however, many physical reasons why surface fog should not be looked upon as a "cloud" at all, and still more why it should not be classed among the *strati*.

Now *stratus* clouds while ever maintaining their sheet-like character appear nevertheless in a variety of detail as to internal structure. Sometimes they are seen as a continuous sheet covering the whole sky, sometimes in detached and somewhat rounded masses, or cloudlets, which as a vast flotilla pass over the sky; still further the cloudlets themselves vary greatly in form, and may be usually arranged in classes, each of which has its own significance. Sometimes these clouds rise in turret-like form from a horizontal base, and sometimes they are "cirriform" or hair-like in structure. I cannot show you pictures of the *continuous* form because it presents no distinctive texture which can be photographed. It is merely a vast uniform canopy of cloud, varying greatly in height. Now it is the "anticyclonic stratus," which often envelopes our skies in winter during long continued quiet weather and easterly winds, then as the thin film of ice particles, called "cirrus haze" floating at an altitude of many thousands of feet, causing Solar and Lunar Halos, and often so thin that the solar rays passing through are sufficiently strong to throw a well defined shadow of objects which stand on the earth's surface. At intermediate heights it forms a canopy which often precedes rain, and which when united with some other varieties, forms the "*strato nimbus*," or cloud of continuous rain. On a screen, however, if we throw a photograph of a low form of stratus, separated into detached masses through which the light of the sun steals and behind which his image is reflected in the sea, the type will be readily detected. This is the form which usually appears at the same level as the strato-cumulus already referred to, and you will observe that it is of considerable density and the horizontal measurements of the various cloudlets are large. In other cases we meet with the stratus in a thinner and higher form, the "cirro-cumulus" of most authorities, and the "mackerel sky" or "sheep sky" referred to in general conversation. In these the cloudlets are distinctly thinner than in those previously mentioned; a large portion appears white from the sun's light having pierced it, but there are still well-defined "shadows" in each cloudlet. Sometimes the cloudlets are elongated considerably into a form resembling the section of a double convex lens, and are hence termed by the Rev. W. C. Ley, "lenticular" stratus, while others appear like rather dense masses of sea-weed or heavy feathers and may be called "cirriform"-stratus or cirro-stratus.

These forms of the *Stratus* are (as a rule) composed of water particles and are responsible for those burrs and coronæ which appear from time to time round the sun and moon, but as we go still higher—say to 20,000 feet or more—we come to the still thinner clouds of precisely similiar structure, but composed of ice particles, and constituting the "high cirro-cumulus," the true cirrus (mare's tails), and the cirrus-haze forms, being thin they appear white as the solar rays pass through them, or cream-coloured when seen through haze. These are the clouds which produce halos, parhelia and paraselenæ, and they are the highest forms known.

Dr. Mill, in the second of this course of lectures, explained that the effect of vapour and clouds was to "temper" the heat and cold of the earth, and remarked that their effect in so doing is very great. He showed that while vapour in the air may be likened to the sheet and blanket of a bed, the clouds are like the Eiderdown quilt which kept the sleeper quite warm, although the temperature of the air in his room might be changing greatly. There is however another effect to which I would draw attention. Thin clouds are like the glass in a conservatory: the rays of "luminous-heat" pierce them and warm the earth, but the "dark-heat" which the earth reflects cannot get away again through them into space, and in this way we often find that at the close of a fine warm bright spell of weather in summer, we have a rather cloudy day with shade temperature far in excess of that of the brighter days which preceded it, and at the same time an oppressiveness beyond anything that can be accounted for by any change that may have taken place in the humidity or electrical condition of the air.

In passing from the stratus clouds at low to those at high levels, we find a law the same as that observed with clouds of the *cumulus* type, viz. the higher the cloud the thinner it is found to be, until in the highest regions the beautiful gossamer threads of the finest cirri alone are found, and beyond them cloud is unknown.

The reason is obvious. The earth, with its vast ocean surface, is the source of all the vapour out of which the cloud-forms are developed; some (of the cumulus type) are formed at the head of the columns of vapour as they rise slowly but directly from the earth, and, as it has been beautifully put, form the capitals of the pillars of vapour as they ascend from the earth; others, of the stratus type, are apparently due to large quantities of vapour, hurried from the earth to the higher regions in a cyclonic swirl, and thence carried out in the sheet-like form, as the ascending current spreads out towards the tops of the anticyclones by which it is fed. Naturally, therefore, from this cause and from the differences of temperature, the lower will be the thicker and denser varieties, the upper thin and transparent.

Reference must be made very briefly to the *mammato cumulus* and *mammato stratus* clouds observed from time to time. The former is often called the "pocky" cloud because it hangs down like large "pockets" from a horizontal base; at other times the pockets are small, and the appearance of the sky resembles more nearly that of a vast mushroom bed inverted—the mushroom heads being downwards. The Royal Meteorological Society has an excellent photograph of such a cloud. In the case of the mammato stratus, the mammæ are still smaller, and the cloud has an appearance akin to that of the surface of boiling wax. I have repeatedly observed that they appear in that part of the country where Westerly winds are about to veer to N.W. But we must now not pursue the consideration of these matters further.

Once above the cloud level we come into the region of Bright Sunshine, and this brings us to the next subject with which I have to deal. By Bright Sunshine I mean those direct rays of sunlight which, escaping the clouds and fogs of our atmosphere, reach the earth's surface with strength sufficient to enable them on passing through a certain form of lens to leave a trace by burning, or scorching, on a carefully prepared strip of cardboard placed at the proper focal distance in the rear of a certain form of lens. The first instrument designed to record Bright Sunshine by burning was that invented by Dr. Campbell, and used for a long time in Whitehall. In it the solar rays passed through a spherical lens, placed within a wooden bowl. The heat rays burned these bowls, each of which was exposed for six months, into a series of furrows, in the manner shown by a specimen exhibited, kindly lent me by the Meteorological Council. The record is exceedingly interesting, but the difficulty of comparing the various bowls made it desirable to introduce something giving a clearer record. Professor (now Sir George Gabriel) Stokes soon devised a frame which should hold the necessary lens and cards, and I now show the instrument as it is in use at a large number of stations in the British Islands, and a modification of it made by Mr. Casella, of Holborn Bars.

Immediately after this instrument came into use, other inventions were brought forward to record, not so much the heating as the lighting power of the solar rays, and dependent on the intensity of the actinic rays. Two—and the chief ones—were designed by Mr. J. B. Jordan of the Home Office—one a very simple and cheap instrument, consisting of a cylinder carrying sensitized paper and perforated in two places by slits, through which the sun's rays could reach the interior; the other (the "Twin" recorder) more complex and expensive, giving a straight trace, on two separate pieces of paper which have to be joined after the "setting" of the trace is completed. It was found that these gave a record in excess of that of the "burning" recorders, but as a portion of the photographed record was faint, the simple process of washing it for "fixing" got rid of a great deal of the surplus, and the permanent record of the two instruments then agreed fairly well. Thus those who want the longer record may get it by measuring the trace before fixing, while those who wish for a record approximating more nearly to that of the Campbell-Stokes instrument leave the measurement until the "fixing" is accomplished. For about fourteen years sunshine recorders have been at work, and in a publication called "Ten Years of Bright Sunshine" the Meteorological Office has placed before the world the monthly values for all the stations from which it was able to obtain the records. I have prepared two maps on which I have plotted the results of these observations. The maps give the mean number of hours recorded in the months of June and December during these years. That for June, the month in which the sun attains his greatest northern declination, shows that the sunniest parts of the kingdom are the Channel Islands, the Southern and Eastern parts of Ireland, and the Western, Southern, and South-eastern coasts of England. All these regions receive on an average more than 200 hours of bright sunshine in this month, and Jersey gets about 234, or more than 7 hours a day. Going northward, the record decreases to a mean of about 180 hours over the North-western and North-eastern districts, and naturally the large towns lag still further behind, Glasgow coming in with only 159 hours, Leicester 152, and Central London with 163. In the most favoured positions these numbers may seem fairly large, and yet at none of them is the record as much as one-half that of the interval during which the sun is above the horizon. The coasts are more sunny than the inland districts, the plains more than the hills. The map for December, when the sun is furthest south, shews that the mean number of sunshine hours has fallen to rather below 60 even in the most favoured parts of the kingdom (which, by the way, are still the Western and Southern coasts); in Leicester the number is only 28, at Glasgow 15, Greenwich 19, and the central parts of the City of London about 4. The difference between the coast and the inland values is increased in favour of the coasts, which at all seasons of the year are much more sunny than the inland counties. It would be interesting and indeed valuable if we could compare values for hills and valleys—some with towns, some without—we cannot yet, but doubtless this is a matter which, like the failings of most things in their infancy, will be set right by time. At present we can but speculate on the result of such a comparison with the probability that in most cases the hill tops would be the brighter on account of the fog in the valleys.

Of the hygienic properties of Sunlight, little need be said even if there were time. The cheering invigorating influence of bright sunshine is seen and felt by all, and has been recognised for so long, that even Solomon wrote, that a "good and pleasant thing it is to see the Sun." Plants and animals alike rejoice in its presence, while in the absence of sunlight all beings become puny and weakly. Still we may have too much of a good thing—and over exposure to bright sunshine in tropical regions is the cause of diseases of the eye, especially in the regions covered by white sand or snow. We cannot, however, help rejoicing that recent investigation has brought out the fact that sunshine is a marvellous disinfectant, and its effects in destroying or rendering inocuous (if not actually useful) the microbes of certain diseases is beyond anything that could have been conceived. How far this discovery may modify the theories of medical treatment of some diseases, it is not within my power, my province, or my time to inquire—but the more intimate our knowledge of the distribution of the prevalence and of the intensity of bright sunshine becomes, the better shall we all be for it.

There is yet another important service that clouds can render—one of which Meteorologists in particular are glad. They enable us to detect the movements of the upper currents of the air in a manner that nothing else does. You will see at once that if we can but ascertain the altitudes at which the different varieties of clouds float in our atmosphere, we can by careful observation ascertain the movements of the upper currents, and thus solve many of the difficulties which confront us when we endeavour to discover the laws regulating the circulation of the wind in the different atmospheric systems. High level stations are very valuable, but then the hills introduce many complications by throwing the air currents out of their natural course. Balloons fail us just at the time when they are most wanted, but clouds often lend us their aid, and a good deal has already been done in utilizing their indications as aids to the forecasting of weather. Unhappily the lower clouds often conceal the upper, or render the detection of their movements very difficult, but Meteorologists have long ago learned, not merely that "half a loaf is better than no bread," but that a very small "crust" is often a great blessing, and that nothing which contributes to our knowledge of the laws of nature is to be despised.

THE POSSIBILITY OF THE SPREAD OF DISEASE THROUGH THE RIVER WATERS SUPPLIED TO LONDON:

A Review of the Evidence given by the Bacteriological witnesses before the Royal Commission on Metropolitan Water Supply, 1893.

By LOUIS C. PARKES, M.D., D.P.H., M.O.H. Chelsea.

DISEASES CAPABLE OF BEING SPREAD THROUGH WATER.

TYPHOID Fever and Cholera were the diseases to which the attention of the Commissioners was practically limited, it being generally recognised that outbreaks of these diseases have occurred in which the proof of origin from polluted drinking water is irrefutable. The characteristic organisms of other diseases have been found in water, but there is little or no evidence that such diseases have been more than very occasionally propagated by means of drinking water. The principal organisms of this nature are the bacillus of tubercle, the bacillus of anthrax, the bacillus of tetanus, the bacillus of diphtheria, and the strepto-coccus of erysipelas. There is a general agreement amongst sanitarians that attacks of summer diarrhœa may be promoted by the use of polluted water, but as yet no organism has been separated and identified which can be regarded in any way as a causative agency in these attacks. The attention of the Commissioners, therefore, was more especially given to the behaviour of the disease poisons of typhoid fever and cholera in water under the natural conditions met with in streams, reservoirs, and filtering beds.

NATURE OF THE DISEASE POISONS OF TYPHOID FEVER AND CHOLERA.

(1.) *Typhoid Fever.*—Eberth's bacillus typhosus was regarded by most of the witnesses as being the probable cause of typhoid fever. Professor Ray Lankester (10,697)* says he "thinks it is in the very highest degree probable that it is the actual cause." The organism is found in the dejecta of typhoid fever patients, and in the spleen and intestinal lymphatic glands after death. It is not known to produce spores. It has been found in several instances in the water supply of places where typhoid fever was very prevalent. On the other hand, experiments on animals do not serve to complete the chain of proof, as in none of the lower animals is typhoid fever a natural disease. Even experiments on human beings might be of little use in eliciting the truth, for, as pointed out by Dr. Sims Woodhead in his statement (Appendix C. 70, p. 493), the condition of the alimentary canal must exercise a very large influence upon the result of the introduction of either typhoid or cholera poisons into the stomachs of individuals. There is, besides, the question of varying individual susceptibility. Eberth's bacillus typhosus bears a strong resemblance to the bacterium coli commune—an organism commonly present in the intestinal contents of healthy human beings, and of some animals. Professor Ray Lankester (10,647) believes them to be closely related forms, and thinks it is quite possible that Eberth's bacillus is only an exacerbated bacterium coli commune—that the one variety may be converted in successive generations into the other by appropriate conditions of cultivation—*e.g.*, the presence of very rich nutriment of a special organic character (10,824). Dr. Sims Woodhead, on the other hand (13,237), believes that the two organisms are essentially different, not so much in form as in physiological activity; and with this view Dr. Klein also agrees (11,011). The two organisms can be distinguished from each other most readily by the indol reaction, bacterium coli commune producing this substance on cultivation, whilst the typhoid organism does not (Ray Lankester, 10,650).

---

* The numbers in brackets refer to the answers given in the evidence, a copy of which is in the Library of the Institute.

Cholera.—Koch's cholera bacillus, or vibrio, stands upon very much the same footing as Eberth's typhoid bacillus. It was admitted by the witnesses before the Commission that the bacillus is present in the intestinal contents in all cases of cholera, and that most observers agree that the organism is not present in other diseases of the alimentary canal. On the other hand, the lower animals are not naturally liable to be affected by cholera, the disease not being interchangeable between men and animals, and consequently the completion of the proof by experiment on animals is not attainable. The bacillus has been found by Koch in the water supplied to populations in Germany affected with cholera.

ENTRANCE OF DISEASE POISONS INTO RIVERS.

The evidence of Dr. Ashby, who made an examination of the Thames and its tributaries between Oxford and the intakes of the London Water Companies (at Hampton), of Dr. Fosbroke, who undertook an examination of the Thames and its tributaries above Oxford, and of Dr. Turner, who examined the Lee and its tributaries, is conclusive as to the abundant opportunities at present afforded for disease poisons to enter the waters of these rivers by means of the liquid and solid waste matters of the populations on the banks. A certain proportion of the water-carried sewage of the river-side populations is subjected to land irrigation on sewage farms. As regards the effluent water from the Oxford sewage farm, Professor Ray Lankester (Appendix C. 61, p. 457) reports that he has never found in it species of bacteria which belong exclusively to sewage, but only common fluviatile forms. The typhoid bacillus has as yet never been discovered in the water of the Thames, but according to Dr. Sims Woodhead (Appendix C. 70, p. 493), relatively so few examinations of the water have been made, that he would have been astonished if the organism had been found. He has no doubt that it has been present both in Lee and Thames waters on many occasions.

SUBSEQUENT FATE IN WATER OF THE DISEASE POISONS.

We may next consider the destiny of the disease poisons subsequent to their introduction into running water. In this connection it will be well to study not only the fate of the microbes, but also, so far as known, the fate of the chemical products—the ptomaines and toxins—which result from the action of large classes of bacteria, both pathogenic and saprophytic, upon the organic matters in their environment.

VITALITY OF DISEASE MICROBES IN WATER.

Dr. Sims Woodhead in his evidence (13,103) stated that in those experiments, in which the most confidence could be placed, it was shown that fifteen days or thereabouts is the extreme limit of time during which the typhoid bacillus can maintain its life, subsequent to its introduction into river water. In water diluted with sewage, the period is shorter; and in fœcal matter, probably shorter still—all these statements being founded on laboratory experiments. The typhoid bacillus grows more rapidly in water containing a considerable quantity of organic matter than it does in pure water, but although it grows more rapidly, it dies out sooner (13,126). As regards the cholera bacillus, Lustig has shown that its behaviour is exceedingly fickle. It may remain alive for many months in distilled water, and may even undergo multiplication in putrefying substances having a slight alkaline reaction (Appendix C. 70, p. 492).

Professor W. R. Smith's laboratory experiments show (10,555) that the cholera organism lived, when protected from light, for fourteen or fifteen days in sterilised distilled water which contained broth culture in amount equivalent to the organic pollution of ordinary sewage; but that the cholera organism in decarbonated water, and the typhoid organism both in distilled and decarbonated water, would live for two or three months, under similar conditions. Exposure to light very slightly decreased the periods of life of the organisms; but in other experiments, where a very much smaller quantity of the broth culture was added, little or no growth of the organisms took place at ordinary air temperatures. All these experiments were made with sterilised water.

Professor Ray Lankester (Appendix C. 60, p. 455) states that the bacillus typhosus introduced into pure distilled water will increase in numbers to a vast extent in twenty-four hours. If the experiment be continued, it is found that a period of maximum development is reached in about three days (10,762), and that then the bacteria decrease in the water generally, sinking to the bottom of the vessel and becoming quiescent. The bacillus will retain some kind of vitality for three months in water which is devoid of other organisms, but disappears much sooner in water in which other harmless species of aquatic bacteria are actively growing. Dr. Klein gave evidence (11,038) that the typhoid bacillus and the diphtheria bacillus have about the same length of life in water. Both kinds of organisms when placed in sterile distilled water gradually diminished in numbers. After from fourteen to sixteen days it was not possible to obtain any more living forms.

It will be seen that some of these statements are not very easily reconcileable with others made by other observers.

No other precise statements fixing any definite limits to the life and activity of disease poisons in water appear to have been made to the Commission; and with regard to these statements it must be recollected that they represent the knowledge obtained under artificial conditions (laboratory experiments) of disease organisms cultivated under similar conditions, and that they are only, therefore, inferentially applicable to similar microbes in a state of nature, and subjected to a natural, as opposed to an artificial environment. A similar criticism is applicable to nearly all the laboratory experiments conducted for this Commission, where an attempt is made to imitate in a laboratory the circumstances and operations of a flowing river.

As regards the chemical products of bacteria—the poisonous ptomaines and toxins—these bodies do not appear to have been identified in or isolated from the rivers forming the water supply of London. Theoretically they may be believed to be actually present in the water in the near neighbourhood of voluminous sewage or animal pollutions, but owing to their instability and the (supposed) rapidity of their conversion by aërobic bacteria into ammoniacal compounds and nitrates, and to the enormous dilution with clean water to which they must be subjected in such rivers as the Thames and Lee, their presence in these waters can neither be definitely ascertained, nor can any weight be given to the view that they are factors of any moment in the potability of the waters.

EFFECTS ON DISEASE MICROBES OF ASSOCIATION WITH FLUVIATILE SAPROPHYTES.

Although full and exact experiments do not appear to have been made, the general opinion of the experts was undoubtedly to the effect that, as stated by Dr. Sims Woodhead (13,125), the presence of saprophytes in water is deleterious to the growth of the typhoid bacillus, the probability being that their products interfere with its growth. On this point the evidence of Dr. E. Frankland is especially interesting, he having been one of the Commissioners of the Rivers Pollution Commission of thirty years ago, who reported most unfavourably as to any of the rivers in the United Kingdom known to be polluted with sewage becoming fit sources of drinking water, but who now apparently has modified his views as to the self-purification exerted by flowing rivers, and the efficacy of sand filtration. Dr. Sims Woodhead (13,162-5) is of opinion that the cholera bacillus is more readily destroyed by the common saprophytic bacteria than the typhoid bacillus; and that the latter organism will retain life for a longer period in pure, deep well waters containing few saprophytes, than in river waters containing a relative abundance (13,215). Professor Ray Lankester reports the result of an uncompleted laboratory experiment (Appendix C., 61 H. p. 458) on the struggle for existence between the typhoid bacillus and normal fluviatile bacteria. He experimented altogether with four different forms of the latter, but was unable to obtain any confirmation of the view that these forms of saprophytes are injurious to or destructive of the typhoid bacillus. The *Bacterium fluorescens liquefaciens*, which suggested by its vigorous action on gelatine the possession of destructive properties, was found to live side by side with the typhoid organism in pure culture for a fortnight, without any diminution in the activity or numbers of either species being observed. Professor Lankester thought it was desirable to experiment with some thirty forms of fluviatile saprophytes, under conditions resembling those obtaining in the rivers (10,676).

It seems probable, in the absence of any other experimental evidence presented to the Commission, that the views held by bacteriologists as to the destructive effects of saprophytic organisms on typhoid bacilli, may be founded on the effects known to be produced on the bacillus of anthrax when cultivated in association with these organisms, and on Surgeon-Major Cunningham's and some continental observers' results with Koch's cholera bacillus when placed in contact with saprophytic bacteria. Correct deductions applicable to other organisms can hardly be made from the behaviour of a totally distinct species like the anthrax bacillus; nor can we altogether ignore the probability that typhoid bacilli developed under unfavourable conditions, whilst losing their virulence, may, under certain conditions, become more resistant to the adverse influences to which they are exposed, than the virulent bacilli from which they are descended; that in fact they undergo a reversion to the saprophytic type of little virulence but large resistive powers. Dr. Sims Woodhead (13,117) says this is certainly the case in cholera. It is probably also the case in typhoid fever and other diseases of the endemic class (see paper by the author on "The Relations of Saprophytic to Parasitic Organisms," *Trans. Epidem. Soc., Vol. X., 1890-91*). Further research on these lines is obviously required, but until our knowledge of the life history of the typhoid bacillus under natural conditions outside the human body is more complete than it is at present, it is premature to say, as the Commissioners have done in their Report (pp. 60, 61), that "when pathogenic bacteria pass into the outer air or water they are in an unnatural medium, in which they can only maintain their existence and power of multiplication for a limited period, during which they undergo more or less rapid attenuation or loss of virulence, and become generally weakened." Future research—indeed the most recent investigations—will probably show that there may be most important exceptions to any such rule.

EFFECT OF DILUTION ON DISEASE MICROBES IN WATER.

There can be no question as to the enormous amount of water with which pathogenic microbes become commingled after gaining an entrance into such a river as the Thames. The commissioners calculated that even under the most unfavourable conditions there could only be one case of typhoid fever occurring in the Thames Basin above Molesey to nearly 300 million gallons of water (Report, p. 59), but this calculation provides for the fever cases being evenly distributed throughout the year, which of course is very far from being the case. The extent of the dilution, however, is not the real point at issue. The important points to determine are the capacity of typhoid or other disease bacilli to persist (possibly in an altered form) and to multiply in water, and the approximate numbers of the bacilli that are required to be introduced to set up disease in the human system. On the latter point there is Dr. Klein's authority for stating (10,978) that no data exist for arriving at a conclusion; and it may be added that individual susceptibility being admittedly so important a factor, it is hardly likely that there ever will be data capable of general application. As to the persistence and growth of the typhoid bacilli in river water, there is only the experimental evidence obtained from laboratory research, which, as already shown, is unfavourable to the contention, but cannot be held to be conclusive as to conditions which the laboratory experiment only feebly imitates. If the evidence of the Tees Valley and Caterham outbreaks of typhoid fever are to be accepted, dilution up to certain unknown limits is evidently a factor of but small moment when concerned with living organisms capable of indefinite multiplication.

EFFECT OF SEDIMENTATION OF THE WATER.

Numerous witnesses described the processes of sedimentation occurring in the river waters, by which suspended organic and mineral matters in the deep and sluggish reaches of the river subside to the bottom, carrying with them entangled in their substance numberless bacteria. Not only is there this subsidence of suspended particles by gravitation when the current is slight or nil, but there is also a chemical precipitation at various places where springs or affluents cause an entry into the main stream of water of varying chemical composition (chiefly as to hardness) from that of the parent river. At such places it is probable that a deposition or precipitation of some of the calcium carbonate dissolved in the water takes place, and this deposit carries with it organic matter in suspension and entangled bacteria.

In Professor Ray Lankester's statement (Appendix C., 61, p. 456) the results of some laboratory experiments are given, which show the effects of subsidence of clay and mud on the number of bacteria in suspension, and also the similar effects produced by the addition of lime to river water. These experiments appear to be a reproduction of similar ones originally conducted by Dr. Percy Frankland and published in the Proceedings of the Royal Society. The net result of this research appears to be that sterilised river mud in stagnant water, in the proportion of 30 grammes of mud to the litre of water, caused a deposition of nearly 75 per cent. of the bacteria present; 2.5 grammes of sterilised kaolin to the litre caused a deposition of over 80 per cent. of the bacteria; whilst 6¼ grammes of slaked lime to the litre caused a deposition of 95 per cent. of the bacteria. In each case the jars of fluid were kept at rest until complete clarification of the supernatant liquid had ensued.

The influence of sedimentation in effecting a deposition of bacteria is, no doubt, very considerable. In the case of the semi-stagnant reaches of rivers, the bacteria in the sediment are deposited in the bed of the stream. What happens to them there is not known. Professor Ray Lankester (10,645) makes the suggestion that there are probably changes going on in the mud (at the bottom of the river) through the agency of the flow of the river, which are not dissimilar, in fact, are probably identical with the changes which go on in the filter-beds. There is, however, a complete absence of any data which would justify any such conclusion. It is probable, indeed, that in times of flood with a greatly accelerated flow, the sedimentary substances are disturbed and tend to become again mixed with large volumes of water, thus possibly, if the bacteria are still alive, reinfecting a stream with polluting or dangerous organisms which had been previously placed *hors de combat*, so to speak, by sedimentary action.

EFFECTS OF AERATION AND OF FLOW.

Evidence was brought forward by Dr. Odling and other chemists to show that the Thames above the water companies' intakes is a well-aërated river, the water being properly charged with its due quantity of oxygen (10,092). The oxygen dissolved in the river-water is capable of destroying at 55° F. about four-fifths of its weight of organic matter, and this destruction is, no doubt, very largely effected through the agency of aerobic or oxygen-consuming bacteria. Dr. Odling calculates that the weight of oxygen in a mile of the river-water at Molesey is about two tons; and it is beyond question that large amounts of organic matter in the river are destroyed by these oxidation agencies, unless the temperature of the water is very low. Although this is the case, there appears to be but small warrant for the assumption that the pathogenic microbes are necessarily a part of the destroyed matters, or that the oxidation processes are unfavourable to the persistent vitality of the pathogenic organisms (Odling, 10,209). Dr. Klein in his evidence (10,990) said that he was not aware of any definite data to go by concerning the influence of flow and of aeration upon these particular pathogenic organisms (typhoid and cholera). There are, he said, pathogenic organisms that would live very well under aëration, in fact would require it.

Agitation might have a deleterious effect on such microbes, because it is known that they grow better and easier when at rest. Dr. Sims Woodhead, too (Appendix C., 70, p. 492), alludes to the possibility of an anaerobic microbe, such as is the cholera or typhoid bacillus in its parasitic condition in the human intestine where oxygen is absent, assuming aerobic properties in water, and becoming more saprophytic in type, but less virulent. It can, no doubt, re-acquire its virulence under suitable cultivation, such as would occur on its introduction into a susceptible person's intestine.

It would appear, then, that the influence of aeration cannot well be separated from that of the influence exerted by aerobic saprophytes (see *Ante*); and all that can with definiteness be said about oxidation in river-water is that it destroys certain kinds of organic matter, and therefore reduces the amount of nutriment available for the growth of all classes of bacteria.

As regards the influence of flow, *per se*—of running water, as opposed to dead or stagnant water—nothing is known. Professor Ray Lankester had initiated some laboratory experiments on the subject (10,807), but the investigation was incomplete, and it is very doubtful if this problem, from its very nature, is capable of being elucidated by a laboratory experiment, however well devised.

EFFECT OF LIGHT.

Bright sunlight is a powerful germicide, and diffuse daylight has a similar but lesser capacity to destroy or attenuate microbic —including pathogenic microbic—life (Sims Woodhead, Appendix C., 70, p. 493). In the case of a river like the Thames, with an average depth of over six feet, it is doubtful what effect the water has in cutting off the active light, and therefore what is the precise germicidal action of sunlight or daylight at different depths from the surface, and under different conditions of clearness or turbidity of the water.

WATER COMPANIES' OPERATIONS QUÂ ELIMINATION OF DISEASE POISONS.

STORAGE IN RESERVOIRS.

As regards the microbes present in the river water which flows through the Companies' intakes to the reservoirs, storage would appear to be productive of two antagonistic results. Sedimentation takes place in the water when at rest in the reservoirs; mineral and organic matters in the form of fine mud are deposited; and probably, judging from Percy Frankland's and Ray Lankester's experiments, some three-fourths of the suspended bacteria accompany the deposit of silt. So far the tendency is to purification. But storage has been shown to be a favourable condition for the multiplication of bacteria (Klein, 10,993), and if it is right to reason from storage effects, as shown in laboratory experiments, to storage in large reservoirs in the open air, we must assume that the bacteria which are not deposited are placed under conditions favourable to rapid multiplication. This is an important matter, for assuming the possibility of a typhoid bacillus, which had escaped the sedimentary action, having the capacity to multiply in the three-parts sterilised water of the storage reservoir, the multiplication by division is so rapid that, dividing once every half-hour, a single bacillus in twenty-four hours will give rise to something like three hundred billions of bacilli (Lankester, 10,900). The witness believed that this rapid multiplication could only take place in distilled water, or in deep well waters shielded from light and containing relatively few saprophytic microbes; and Mead Bolton's observations (10,757) also show that the numbers of bacteria in filtered river water in a reservoir remain fairly constant from day to day, but when the water is taken out of the reservoir and kept in a vessel for twenty-four hours, an enormous multiplication of organisms will be found to have taken place—(seventy-three bacteria developed into half a million). The constancy of numbers in the reservoir water may be due to sedimentation and multiplication balancing each other, but there is no satisfactory explanation of why the water removed from the reservoir should exhibit such a marvellous increase.

Sand Filtration.

The classical researches of Dr. Percy Frankland, made during the years 1886, 1887, 1888, show that sand filtration removes from tne river-water on an average 97·5 per cent. of the microbes present in the case of the Thames, and 95·7 per cent. of the microbes present in the Lee water (East London Co.). These are the microbes which are capable of growing in gelatine plate cultivations at temperatures below that at which gelatine liquifies. A similar investigation conducted in 1892 confirms the results of the earlier researches. Out of sixty-one samples of filtered water collected at the several water companies' works direct from the lower portions of the filter-beds or from the filter-wells (11,125), only one sample yielded more than 100 colonies per cubic centimetre, whilst the average number was only twenty-nine (Appendix C., 64, p. 474). With regard to the bacteria present in the filtered water, Dr. P. Frankand remarks "only a very insignificant part of them can be derived from the unfiltered water, for the numbers in the filtered bear no relationship to those in the unfiltered waters; the majority of the bacteria in the filtered water are, therefore (during the summer months—11,080), attributable to post-filtration sources," the filter-beds, the channels, culverts, and wells being of course not sterile. These are the results of gelatine-plate cultivations, and are, of course, very satisfactory as far as they go, but, as pointed out by Dr. Klein, it is not by any means the same thing testing a sample merely by gelatine, and testing it also at higher temperatures, such as are to be obtained in bouillon cultures (11,002). There is, therefore, a possibility, not yet disproved, that microbes pass through the filter-beds, which can be cultivated at high temperatures, but do not grow on gelatine-plates.

All the witnesses were agreed that the efficiency of the sand filter-beds in intercepting bacteria is due to the formation of a superficial gelatinous deposit or membrane on top of the sand. The bacteria become attached to, and entangled in the colloidal mass, and are, consequently, prevented from passing down into the deeper beds of sand and gravel. Professor Ray Lankester describes this filtration as like the dialysis through a fine jelly, which is capable of intercepting the very smallest bacteria if there is no rupture or loss of continuity in the material (10,682). This gelatinous film which forms on the top layer of sand consists, no doubt, very largely of intercepted organic matter and saprophytic bacteria. From Dr. Percy Frankland's statements (11,083), it appears to be sufficiently well formed to be effective in intercepting bacteria within two or three days after renewing the top layers of sand in the filter-beds. It follows, therefore, that the filter-bed does not attain its normal efficiency in the interception of bacteria until it has been in use a couple of days after the periodical renewal. On the other hand, there was no evidence of the efficiency of the sand filter-beds, *quâ* bacterial interception, being reduced by prolonged use, even for so extended a period as sixty-eight days (11,097). It would seem that the organisms tend to grow down deeper and deeper into the beds, and might possibly in time grow quite through the interstices of the filter, and so re-appear in the filtered water. But owing to the thickness of sand this process must occupy a very long time. The reason why the top layers of sand should be skimmed and renewed periodically is to prevent other filter-beds being overtaxed, because the filtration becomes slow in the old beds, owing to the thickness of the gelatinous coating and clogging of the top layers. If certain filter-beds are working too slowly, others have to be pressed—possibly resulting in inefficient filtration—

in order to make up the volume of filtered water necessary for the daily supply.

No evidence was forthcoming as to there being any "selective filtration" of micro-organisms by the sand filter-beds; *i.e.*, any tendency of the filters to arrest the larger microbes, and allow the smaller ones to pass through. It seems to have been generally acknowledged that the individual smallest bacterium now known is only about ten times smaller than the individual largest bacterium, and that consequently mere difference in size, having regard to the size of the pores in sand-beds, was not a factor of any moment. Dr. Klein (10,945) mentioned some experiments made by Dr. Beyerink, of Delft, to show that certain bacteria of very small size, which cause phosphorescence in suitable materials, passed through the pores of porous porcelain in a Pasteur-Chamberland filter. Dr. Percy Frankland, however, thinks (11,097) that these phosphorescent bacteria grow through the interstices of the filter, and thus pass into the filtered water. He says that the pores even of a Chamberland filter are sufficiently large to admit of organisms passing, but in consequence of some attraction between the porous porcelain and the organisms, the latter are arrested in traversing the circuitous paths through the filter.

The subsequent life history of the organisms, which are arrested in the gelatinous mass on the surface of the sand filter-beds, still remains to be studied.

Something remains to be said about the acknowledged facts as to sand filtration above indicated. Taking Dr. P. Frankland's results, showing twenty-nine organisms per cubic centimetre, as being an average of the number existing in the London Water Companies filtered water under present conditions, this means a very large number even in so small a quantity as a gallon; and when we consider the number of gallons daily supplied to an average sized house in London, the possibilities of pathogenic organisms being introduced into a cistern on some occasion or another are not so very remote, even taking into account the supposition that these organisms constitute an almost infinitesimal numerical fraction of the harmless species. If so introduced into a cistern—a darkened reservoir of stagnant water—the possibility of multiplication cannot be dismissed, as it has not been shown to be an impossible occurrence.

The argument that typhoid bacilli do not exist in the filtered or unfiltered Thames water, because they have never been found, is of course untenable. So vast are the volumes of water present in the Thames, and operated on by the water companies, that unless the typhoid bacillus was evenly distributed through this great mass of fluid, the methods of examination of a gallon or so here and there shaken up and then tested as to one or two cubic centimetres, must infallibly have failed to detect the organism. Better results will probably be obtained by submitting to bacteriological examination portions of the gelatinous film removed from the filter-beds, which represent for each square yard comparatively large volumes of water; and also by an examination of the similar deposit coating a Chamberland or Berkefeld filter which is attached to a water main and is continually in use. By the use of Parietti's method (Appendix C., 61, p. 458) it will then be possible to speak with greater certainty as to the absence in large volumes of water of the typhoid bacillus, provided that the intercepted bacillus is not destroyed or rendered unrecognisable by its more or less prolonged stay in the gelatinous film coating the filters.

THE EFFECTS OF FLOODS.

If the water companies had sufficient capacity of storage reservoirs, there could be no question of the harmfulness of floods. But it is at present a fact that few if any of the companies have sufficient storage to obviate the necessity of taking in muddy, turbid water during prolonged floods in the rivers. Such water, of course, contains micro-organisms greatly in excess of those present in the river water under normal conditions. The sedimentation in the storage reservoirs may be incomplete; an attempt has to be made to filter a turbid water and supply a sufficient volume for the needs of the consumers, with the result that on occasion a cloudy and insufficiently filtered supply is pumped to London. It is only, of course, very occasionally that a distinctly bad or low class water is thus supplied to London consumers, but the possibility of such an occurrence has still to be taken into account.

As regards disease propagation, the dangers of flood water depend upon the foul substances washed into the river from ditches, ponds, drains, and refuse heaps on the banks. If it is true that the typhoid bacillus cannot maintain its vitality for more than a few days in fæces, sewage, and cesspool accumulations, the recent nature of such matters and the date of their deposition are all important. But if we are to go by practical experiences such as that furnished by the Tees Valley epidemic of typhoid fever, and if we refuse to trust the at present imperfect and inconclusive bacteriological evidence on this head, the addition to river water of human excrement by flood washings must be regarded as serious, no matter whether such excrement is of recent deposit or not. The dilution of foul matters with water is, no doubt, very great during periods of flood, but the addition of filth of all kinds may be correspondingly excessive; and at least one witness regarded the occurence of floods as a distinct menace to the health of water consumers (Sims Woodhead, 13,152). Fortunately floods occur as a rule late in the winter or during the colder seasons, when the low temperature of the water prevents any development of pathogenic bacilli, and may thus completely counteract the dangerous properties of flood water.

It must also be stated that, so far as known, no outbreak or excessive prevalence of typhoid fever in "water-London" has followed upon summer or autumn floods in the Thames or Lee Valleys, although it would no doubt be difficult to dissociate such an occurrence from the normal late summer rise in enteric fever prevalence. There appears, besides, to be no evidence pointing to excessive or abnormal enteric-fever prevalences in populations on the river banks above the water companies' intakes being accompanied or followed by a rise in enteric-fever mortality in London districts (Odling, 10,074).

CONCLUSION.

The Royal Commissioners expressly stated in their Report (p. 63) that they regarded Bacteriology as still in its infancy, and they did not consider that the results obtained by experts in the science, in regard to the persistence or destructibility of pathogenic bacteria, could have any such position of absolute certainty assigned to them as would dispense with the evidence of experience. With this view all who have read the bacteriological evidence placed before the Commission will agree. There is not merely the want of harmony between the results of different observers, but there has been too little insistence on the artificiality of the experimental methods pursued, and on the danger of any reasoning from such observations being applied to the circumstances and operations of nature on the large scale. There is besides the almost universal tendency to regard the microbes of disease as specific entities, and to take little account of those possible modifications and reversions of types about which so little is known, but which, when understood, will probably supply a key to the solution of the most intricate epidemiological problems.

REVIEWS OF BOOKS.

"SEWAGE DISPOSAL IN THE UNITED STATES."*

The authors state that the chief object in publishing this book is to enable future Americans, who wish to study the question of sewage disposal in detail, to have available the experience that has been gained out of their country without having to go abroad for it. This book, however, will also be welcomed by English engineers, as it contains a record of many works of sewage disposal which have been executed in the United States, with valuable practical information as to their working, obtained apparently by careful observation at the various places referred to. The authors have extended the scope of their enquiries beyond that which would be understood by the title of the book, namely "Sewage Disposal," and its interest and value is increased thereby. Investigations by the State Board of Health of Massachusetts as to outbreaks of typhoid fever, the causation of communicable diseases and the infectious diseases of animals, as bearing upon the subject of water-borne communicable diseases of human beings, are considered. The pollution of rivers and the investigations that have been made as to the self-purifying influence of running streams and the discharge of sewage into tidal waters are dealt with, and various legal decisions in America are given. Some useful data are tabulated as to water consumption and rainfall, bearing on the question of the quantity and variation in the rate of flow of sewage, and consequently on the means for its disposal. The circumstances in which the separate system of sewerage has been adopted in various cities in America are summarized from reports of the engineers engaged, including several references to works carried out by Col. Waring, whose name will always be identified with this system.

In considering the methods for the disposal of sewage, the authors refer to and review the experience of recent years as to nitrification and the nitrifying organism. The investigations of Mr. Robert Warington in this country are naturally given prominence to, and the two valuable papers by that observer, one before the Society of Arts in 1882 and that before the British Association in 1884, are quoted at length. The more recent information contained in the reports of the State Board of Health of Massachusetts and the observations of Dr. Percy Frankland and others are quoted, and give a clear *resumé* of this subject. The arrangements for distributing sewage on land are described, and data are given in respect of this and of the agricultural points involved. The published reports of the Commission on Sewage of Towns and the Royal Agricultural Society are referred to largely. The utilisation and preservation of the heavy green crops from sewage farms are dealt with in a chapter on Silos, which may be advantageously read in conjunction with the Report on Ensilage issued a few years ago by a Commission, which was presided over by Lord Walsingham.

---

* By Geo. W. Rafter and M. N. Baker. New York: D. Van Nostrand Co. London: Sampson, Son, Marston & Co., Limited.

The descriptions of sewage farms and precipitation works are very interesting, and are well illustrated by diagrams. These will be studied with advantage by engineers engaged in designing works of this kind. Some experiments which were made by the Sewer Commissioners of South Framingham, Massachusetts, in the cold weather of January, 1893, with sewage applied to frost-bound filter beds may be referred to. It is stated that when the filter bed was frozen 18 inches deep and had 10 inches of snow upon it (the thermometer being at 6° F. below zero) the plot was dosed with sewage at a temperature of 50° F. An area of seven-eighths of an acre received 300,000 gallons at first, and in six hours part had passed to the under-drains. The following day five times this volume was applied, and at the end of the fourth day the frost was out of the land and the sewage had disappeared. There is, however, no record of whether purification was effected or not, as no analyses of the effluent are given. This experience therefore should be taken in conjunction with the observations published in the twenty-third report of the Massachusetts State Board of Health, where it is stated that no nitrification took place in filter beds exposed to frost and snow until the temperature began to rise in the spring. As it is stated in the latter case that when the filter-plots were protected by canvas covers, almost as good results were obtained in winter as in summer, it will be seen that the experiment in the book might disappoint those who had to depend on land or filter beds to prevent the pollution of streams by sewage disposed of on land during extremely cold weather. Mr. Warington's early experiments at Rothamstead showed that the high temperature of summer had a most favourable influence in increasing the oxidizing action of the soil.

The fact that this book is the joint production of two observers who were engaged (as stated in the preface) in the same pursuit, unknown to each other, will account for its arrangement leaving something to be desired, as descriptions of similar works are placed wide apart, instead of together. It is, however, a valuable contribution to sanitary literature, and deserves commendation.

HENRY ROBINSON, M.INST.C.E.

NOTES ON SANITATION ABROAD.

HYGIENE AT PARIS AND IN FRANCE GENERALLY.

By Dr. Emile Vallin.

Translated by G. J. Symons, F.R.S.

In response to the request which has recently been made to me by the Secretary of The Sanitary Institute, I purpose giving periodically a brief account of the progress of hygiene throughout France generally, and in Paris in particular. My reports will refer to important discussions in Parliament, in the Academies, the Councils of Hygiene, the Municipal Council of Paris, the Societies of Hygiene, the Laboratories, and the Faculties. The interesting facts observed during epidemics in the interior or coming from abroad, new books, memoirs, and inventions will be briefly mentioned, with personal and independent remarks thereon; appointments to public offices, awards given, and obituary notices of persons who have been connected with hygiene; adding also, as occasion may afford opportunity, the little facts which will satisfy the curiosity and concurrently make known the progress of hygiene throughout the country. These notes, written *currente calamo*, will be in some sort a familiar conversation with the reader, and the aim will be to be candid and just, also not to be wearying.

Article 15 of the Law of the 30th of November, 1893, upon the practice of medicine, provides that all medical practitioners shall be bound, under penalties, to declare to the public authorities the existence of infectious diseases whereof the lists will be drawn up on the advice of the Academy of Medicine and of the Consulting Committee of Public Hygiene. The list definitely settled, comprehends the following diseases:—typhoid fever, typhus, small-pox, chicken-pox, scarlatina, diphtheria, sweating sickness, cholera, diarrhœa, plague, yellow fever, dysentery, puerperal infection (when the subject of the pregnancy shall not have demanded secrecy), and ophthalmia in the newly born.

In execution of the ministerial decree of the 30th November, 1893, each practitioner has received, since the 15th or 20th of February last, a memorandum book, of which the detached leaves serve as post-cards bearing the address of the Maire, and that of the Prefect; and the doctor is bound to post a leaf after having written on it the address of his patient, the name of the disease, or the number of the class corresponding to that disease. He himself need not sign it, as the leaf bears the number of the book furnished to the practitioner. The Medical Officer having received the leaf, he, according to the case, sends disinfectors, inspects the house with regard to its sanitary arrangements, and prevents, in the best possible way, the spread of the infection. All this prophylactic work is entirely gratuitous.

The ministerial decree has not been without stirring up opposition and discontent, in our opinion greatly exaggerated. It has been pretended that professional secrecy has been violated; and this argument has been somewhat misemployed. The captiousness is based solely on the subject of puerperal infection; and I have proposed, as reporter of the Academy of Medicine, to limit the obligation to report puerperal infection to those cases where the secret of the confinement will not be demanded. The Academy having rejected this restriction, it has been re-established by the Minister. It was found that this was an insult to the profession,—the numbering of the memorandum-books which had been delivered to the practitioners (*i.e.*, this numbering was treating them like cabmen or policemen). There has been much exaggeration here:—the new measures disturbing the habits and shocking the prejudices; but time will sweep away these petty oppositions. The measure is excellent; it has long been demanded by French hygienists as the basis of all prophylaxes against epidemics. The example of England assures us that this arrangement will work well, and prove to be of great utility. The large number of notifications made in Paris during the last few months proves that the majority of medical men recognize its importance and necessity.

At the Academy of Medicine, the new cases of resuscitation of the asphyxiated by drowning, by the process called "*of the tongue*," confirm the excellence of the means suggested by M. Laborde to terminate the state of apparent death. The tongue is drawn out regularly twenty or thirty times per minute; hiccough is provoked, also retching, by exciting the back part of the throat; and in about a half or quarter of an hour, sometimes sooner, respiration is re-established.

An "alienist" (*i.e.*, one engaged in the treatment of the insane) much esteemed in Paris, Dr. Mottet, has been poisoned this winter, and has been seriously ill through having been for some minutes in a cab which had been warmed by means of small pieces of coal, the windows being closed. Frequent accidents from the same cause, sometimes with slow and insidious forms, occur every winter; and at the suggestion of MM.

Brouardel, A. Gautier, Moissan, and others, the Academy has prohibited the warming of cabs by slow combustion coal stoves. The employment of that mode of warming can be tolerated only when the products of the combustion, and particularly the oxide of carbon, cannot escape into the interior of the vehicle. Many omnibuses and tramcars in Paris are warmed by stoves so arranged that the flattened cylinder containing the coal is perforated and placed under the floor of the vehicle in the open air; or so that the upper surface of the stove forms the floor itself, and therefore it is impossible that any gases so produced can enter the interior.

An epidemic of typhoid fever has suddenly broken out in Paris at a time of the year when this disease is rare, and when for many months it had disappeared. It began to develop itself about the 15th of February, and ceased at the end of April. Its very rapid advance has been rather that of a sudden poisoning, than that of an ordinary epidemic. The infected quarters have been almost exclusively those supplied with water from the sources of the Vanne, which is justly celebrated for its purity and freshness, and which supplies the centre of Paris and all that part of the city which is south of the Seine. Although the fact has not yet been demonstrated, it seems that there is a connection between the epidemic of Paris and some little epidemics of typhoid fever observed at the same time in certain villages (Rigny-le-Ferron) in the valley of the Vanne, immediately adjacent to some of its affluents. It is well known that the principal sources are admirably protected: and they furnish daily to Paris 125,000 cubic metres of water whose purity is above suspicion. But to increase the amount, there are caught, by means of pipes, little springs of water which come to the surface, perhaps from rains which, before percolating, have washed fields that have been fertilised with manure; and the depth of the drain pipes is said to be sometimes insufficient to secure perfect filtration of the water. This is as yet only an hypothesis; the bacteriological analysis of the water of the Vanne not having revealed the presence of the bacillus of Eberth. Nevertheless, wrong or right, the doctors and the public are persuaded that the water of the Vanne has been accidentally contaminated; and as confidence in even the best of the filters is not absolute, one part of the population consented to drink the water only when boiled, iced, or made into tea. Those districts and barracks which were supplied with Vanne water were almost the only ones attacked. Moreover, since the beginning of March the water from the lower levels has been excluded from the Vanne aqueduct.

At the Society of Public Medicine and of Professional

Hygiene, Dr. Diverneresse read, in the month of January, a very interesting paper on rendering inoffensive the cleansing of ponds. The muds are dragged up from under the water by means of the pipe of a pump of such sort that the bed of water which covers the mud prevents the freeing of bad odours and dangerous exhalations. Further, the mud drawn up has been disinfected by the aid of a mixture of 200 grammes of quick-lime and 500 grammes of sulphate of iron to the cubic metre. The paper published in the *Revue d'Hygiene et de Police Sanitaire*, of February, 1894, shows that for disinfecting 2,500 cubic metres of mud from the Lake of St. Mandé, there have been employed 1,000 kilograms of sulphate of iron, costing altogether 90 francs, and five cubic metres of quick-lime, costing 175 francs; these make an outlay of 265 francs for disinfectants; and the result has been extremely satisfactory. The procedure deserves to be generally adopted for the cleansing of ponds, canals, and ditches; and for the draining of lands which are marshy, and rich in organic matter. The method has been spoken of favourably for many years by M. Rabot, a distinguished chemist in Versailles; but this time it has been applied on a large scale; for, the cleansing of the great canal in the park of Versailles has occasioned the raising in this manner of 85,000 cubic metres of mud which mass has remained in the park a whole year without having caused any sickness or even any annoyance.

The International Sanitary Conference which met in Paris at the beginning of February, terminated its labours at the end of March. The delegates have been the objects of very sympathetic manifestations in the brilliant receptions which have taken place at the Ministry of Foreign Affairs, with the Dean of the Faculty of Medicine, at the dinner which was given them by the Society of Public Medicine, at the Hôtel Continental, etc. General agreement seems to have prevailed on almost all points, and several English journals, notably the *British Medical Journal*, have published the convention *in extenso.*

The Faculty of Lille has just suffered a great loss by the sudden and very unexpected death, on March 27th, of the eminent professor of hygiene, M. J. Arnould, brought about in some way by an acute affection of the lungs. M. Arnould was the author of a treatise on hygiene which is a classic in France, and of which he has prepared a third issue. It is a veritable monument of erudition. He had a critical sense the most penetrating, a style brilliant and animated, a pen of a delicate yet incisive lightness, a profound and matured knowledge of the works of German authors, and of numerous scientific travels in all the great centres of Europe. He was an example of scientific honesty and possessed an uncommon ardour of conviction, in short the qualities of a savant and critic of the first order. M. Arnould was a corresponding member of the Academy of Medicine, and had filled the highest posts in the medical department of the army. He leaves behind him keen regret based upon profound esteem.

We must notice likewise the death of Dr. Ollivier, member of the hygienic section of the Academy of Medicine; and that of M. Ch. Herscher (on January 25th), a distinguished engineer, whose systems of warming, and, above all, whose disinfecting high-pressure vapour stoves are so well known in France and throughout Europe. M. Herscher has been a very useful collaborateur of hygiene in our country. He has created in his factories a museum of industrial hygiene, and has thus distributed through France the germs of Sanitary engineering which is so flourishing in England, and which has the practical sanction of scientific and experimental hygienists.

At Asnières-Gennevilliers, near the banks of the Seine, on April 27th, was unveiled the monument erected by subscription to the engineer Durand-Claye, who died so unexpectedly on April 27th, 1888, at the early age of forty-six, in full activity and full success. It was Durand-Claye who had undertaken on behalf of Paris the double task; (1) To abolish the foul closets which defiled the houses, and the mode of emptying them which was so disgusting, and to send everything rapidly to the sewage outfall; (2) To stop the direct discharge into the river, and at the same time to stop the fouling of the river and turn the sewage to profit by irrigating land.

The colossal stature of Durand-Claye, by Boucher, stands at the very entry to the formerly arid plain of Gennevilliers, which irrigation has converted into a fertile oasis covered with trees, vegetables, and flowers, worth more than 10,000 francs le hectare (£160 per acre), with a daily increasing and healthy population, and where no unpleasant smell suggests the source of all this fertile vegetation.

The Préfet de la Seine and the representatives of the great public authorities celebrated at the same time the brilliant abilities of Durand-Claye, and the important object of the purification of the earth to which he devoted his life, as well as its great utility. The very day after the above-mentioned ceremony, the Chamber of Deputies voted by 412 to 83, 117 million francs (£4,700,000) for completing the sewerage of Paris, and especially for carrying some of the discharge to new irrigation lands at Achères, on the north of the Forest of St. Germain. This sum will moreover cover the cost of purchasing two new sources of water supply (Loing and Lunain); additions to the present supply to Paris which is about 250 litres (55 gallons) per head per diem, of which about one fourth is almost irreproachable spring water.

The Press, both political and industrial, is still devoting much attention to a gigantic project promoted by M. Duvillard for constructing an aqueduct to bring water to Paris from the Lake of Geneva. We fully recognise the desirability of an abundant supply, and admit that the Lake of Geneva would furnish it, but the cost would reach 600 million francs (£24,000,000), many accidents are possible along a course 300 miles long. What would happen if in time of war an enemy cut the line? We do not think that the proposal has been sufficiently considered—it raises many grave problems, and before the Swiss lake fills the Parisian water-bottles, the Municipality had better acquire some of the excellent springs of the central plateau of France, and lead them to the suburbs of Paris by aqueducts less costly and more secure.

SANITARY MATTERS IN THE UNITED STATES.

Col. G. E. Waring, M.Inst.C.E.

Nothing has been done in recent years in this country of such importance and interest to the sanitarian as the very thorough and continued investigations of the Massachusetts State Board of Health, as to the natural processes involved in, and the practical results to be secured by, the intermittent filtration of sewage through various media.

These investigations began in 1887 by the construction of experimental works on a large scale in the outskirts of the considerable city of Lawrence, one hour by rail from Boston. The apparatus was of two classes; one being water-tight tanks sunk in the ground 6 feet deep, and having an area equal to one two-hundredth of an acre,—of these there were six or more; second, a series of iron tanks above ground of the same depth, but only 20 inches in diameter. These tanks were filled with various materials, ranging from fine river silt, peat, and garden soil, to sands of various coarseness, and even to pebble stones as large as the ball of one's thumb. The experiments are made on the ordinary dry weather flow of the city sewers.

The investigation has now been continued for more than six years, and has been controlled at every step by the most careful chemical and bacteriological investigations. The processes and even the detailed results are too minutely described for even summarization here. They are fully set forth in the published reports of the Board of Health, notably in a special volume on the filtration of sewage and water, published in 1890. The best result in continuous practical filtration was obtained by the use of a rather coarse mortar sand, which produced a purity superior to that of most of the public drinking-water supplies of the State, at the rate of about 100,000 gallons per acre per day, more than 99 per cent. of the free and albuminoid ammonias of the sewage being converted into nitrates, and all but a small fraction of 1 per cent. of the bacteria being destroyed, with an indication that the few existing in the effluent were harmless bacteria that had grown in the effluent drains. The most instructive result was obtained in the use of gravel stones "as large as beans," which had been washed clean of sand before they were put into the tank. The bed was 5 feet deep. The sewage was applied nine times a day, six days in the week, at the rate of 81,400 gallons per acre, per day. After that amount had been applied daily for more than seven months, it was found that 98·6 per cent. of the organic matter, shown by the sum of the ammonias, had been nitrified, and more than 99 per cent. of the bacteria had been destroyed. This was a remarkable result with an effluent averaging 70,000 gallons per acre, per day, for every day in the year. In 1890, the quantity was increased for three months to 126,000 gallons for six days in the week. The purification and destruction of bacteria were substantially the same. The application was such that each pebble was kept covered with a thin film of liquid in continual contact with the air spaces between them. "The liquid starting at the top as sewage, reached the bottom within twenty-four hours, with the organic matter nearly all burned out. The removal of this organic matter is in no sense a mechanical one of holding back material between the stones, for they are as clean as they were a year ago; but it is a chemical change, aided by bacteria, by which the organic substances are burned, forming products of mineral matter which pass off daily in the purified liquid."

These two references are only striking examples of hundreds of the valuable determinations effected. The State of Massachusetts spends about 20,000 dollars per annum on these investigations.

In sewerage, the most notable work now being carried on is the sewerage of the City of New Orleans by an incorporated company, under a franchise giving it the right to collect rates from householders, compelling connections, and constituting the rates a lien on the property. The population of the city is about 300,000, and its area is 12 feet higher at the river bank than at the swamp in the rear of the inhabited territory. At certain seasons the river runs bank-full. The sewerage is to be carried out according to what is known here as "Waring's System." All rain-water being rigidly excluded, and all sewers to be automatically flushed, and ventilated through the soil-pipes of the houses, no trap being allowed on the main drain. The main sewer lies at the rear of the town, and the sewage is to be pumped from a depth of 27 feet through a force-main delivering into the Mississippi River below low water mark.

On the Atlantic Coast, the City of Brunswick (Georgia), standing on a low, saturated sand formation, bordered by a large tidal river, is now being sewered by the same system, the main sewer delivering into a pumping well five feet below tide, the sewage being driven through a force-main, of which the outlet is at the bottom of the river, 100 feet beyond low water mark and some twenty feet below low water level. The mean rise and fall of the tide is seven feet, and parts of the city are not more than a few inches above extreme high water.

The construction of this work was stimulated, as had been that of Memphis in 1880, by the occurrence of a severe epidemic of yellow fever (in 1893). Serious, and often fatal, malarial fevers prevail every year, fostered no doubt by the saturation of the ground nearly to its surface. The under-drains laid in connection with the sewers have reduced the level of the water of saturation nearly to the level of low tide, so far as the work has been completed, about two-thirds of the district. The whole is to be finished next year, but owing to the tropical climate, work is suspended from June 1st to November 1st.

THE ELEVENTH INTERNATIONAL MEDICAL CONGRESS, ROME, 1894.

By Dawson Williams, M.D. (Lond.)

The Eleventh International Medical Congress, which met at Rome in the last days of March of this year, was the most gigantic assembly of the kind which has ever taken place. To quote the words of a recent writer in the *Nuova Antologia:* "It is a fact beyond all dispute that the Roman Congress has registered the apogee of International Medical Congresses, and without fear of making a false prediction we may anticipate from this period onward a steady decline in their magnitude."*

---

* Quoted in the *Lancet*, May 26th.

The elaborate arrangements of the Italian Executive Committee would probably have worked very well if the membership of the Congress had been limited to medical men, for the number which would then have attended would perhaps have been about 3,000. Any person, however, who formally professed an interest in the work of any Section was entitled to become a Member, and every Member was permitted, nay invited, to bring as many guests as he chose.

This invitation to a Spring holiday in Italy and the promise of special facilities for tours and sightseeing, with the inducement of reduced railway fares, brought together a heterogeneous collection of tourists of both sexes, of whom a large proportion never took any part in the serious work of the Congress, though they produced by their numbers serious confusion in the Bureaus and, when reinforced by great numbers of the inhabitants of Rome, unmanageable crowds at the entertainments.

Of the warm welcome extended by Italians of all classes to their guests everyone who experienced it will always retain a grateful remembrance. The King and Queen attended the opening ceremony, and in many other ways showed their interest in the Congress. Professor Baccelli, Minister of Public Instruction and Professor of Medicine in the University of Rome, was President of the Congress, and he had the co-operation of Signor Crispi, the President of the Council of Ministers, and of all his colleagues in lending to it official recognition and support.

That the Italians themselves hoped great things from the Congress was clear, and that their expectations were in a large measure fulfilled will not be denied. The ordinary traveller looks rather to the evidences of Italy's glorious past, and is continually reminded of the days when the Peninsula was divided into many petty states constantly warring against each other. The *Congressisti* of 1894 heard asseverations on every hand of the glorious future which awaits United Italy. They saw moreover many proofs of the reality and force of the new spirit which animates the modern Italians, the "not degenerate sons," as they love to say, of Old Rome. This new spirit is evident, especially in two directions, in the eagerness with which projects for the improvement of middle and higher education are pressed forward, and in the interest shown in matters affecting the public health. Indeed to many Members the advances already achieved in this direction afforded more interesting matter for enquiry and study than the formal proceedings of the Congress itself.

The President of the Section of Hygiene and the Chairman of the Committee which organised the International Exhibition of Medicine and Hygiene was Professor L. Pagliani, Director of Public Health. The Bureau of Public Health is a Department of the Ministry of the Interior, and was created by Signor Crispi when Minister of the Interior in 1887. Its position and functions were legalised by the Law of 1888, which is the principal sanitary enactment in force in Italy. Attached to this Bureau are a series of laboratories which were open to the inspection of Members of the Congress. These laboratories include a chemical and a microscopical and bacteriological laboratory, both possessing special facilities not only for routine examinations but also for researches required by the Director into subjects still in need of investigation. There is also a physical laboratory with photographic rooms, a museum, and a lecture room. Under the direction of the Bureau and in the same building as the laboratories is the Vaccine Establishment, where calf vaccine is prepared for the use of the whole kingdom. During 1893 the number of persons vaccinated with lymph supplied by this establishment reached the very large total of 2,353,716. The precautions taken to ensure the purity of the lymph, and the healthiness of the animals from which it is obtained are of the most complete description.

Attached to the Bureau of Public Health is a school of public hygiene for physicians, veterinary surgeons, chemists and engineers. The instruction given is entirely practical and is carried on in the laboratories. At the end of each course, which lasts five months, an examination is held, and the successful candidates receive diplomas which entitle them to a preference in applying for sanitary appointments. The total number attending the school in 1894 was 90, the majority, 65, being medical men.*

The sections met in the new Policlinico Umberto I, a magnificent building, not yet complete, which afforded ample room for the meetings but was at a very inconvenient distance from the centre of the city. The discussions in the Section of Hygiene were animated but somewhat confused, and on several occasions much time was spent in disputes on questions of procedure. Not all of the papers were of international interest, but upon several points an expression of opinion was obtained from the Section though no formal resolutions were adopted.

Dr. Louis Csatary de Castar, councillor and sanitary delegate of the General Council of Hygiene of Hungary, and of the Board of the Hungarian State Railway, read a paper on Quarantine, in which he warmly commended the decisions of the International Sanitary Conference of Dresden which freed passengers and commerce from the obstacles imposed by the superannuated institutions of land quarantines, and by the senseless prohibitions on merchandise said to be liable to carry infection. The experience of Constantinople last year afforded a fresh instance of their uselessness; a quarantine of from five to ten days failed to prevent the entrance of the disease and succeeded only in emptying the hotels, destroying retail trade, checking manufacture, and in reducing the working classes to a condition of poverty which greatly increased their liability to disease. He summed up the measures which were really effective for preventing the invasion and spread of cholera in the following propositions: "(1) The maintenance of a state of things favourable to health and the salubrity of the country by hygienic laws; (2) notification and immediate communication of the centres of cholera; (3) severe isolation and disinfection of the first cases; (4) sanitary inspection of travellers, isolation of the sick, and disinfection of the carriages and vessels in which they were travelling; and (5) a rigorous international observation of the places whence cholera can come to Europe." He condemned in particular the application of quarantine to the travellers by the Orient Express, observing that an experience of thirty-four years had taught him that it was a very rare event for a traveller to be taken ill with cholera during his journey.

Professor Ruata of Perugia uttered a needed warning against the reimposition of quarantine, under the name of "isolation." After a brief discussion which discovered the greatest unanimity the following proposition was adopted by the Section: "The International Congress of Medical Sciences assembled at Rome declares that the decisions of the International Sanitary Conference of Dresden are in accordance with the principles of medical and hygienic science; consequently the quarantines on land and the restrictions placed on the running of railway trains are useless and injurious. The Congress declares that it is necessary, in the interests of commerce, that all Governments without exception accept the decisions of the Dresden Conference."

---

* Professor Pagliani presented to the Congress a pamphlet entitled "*La Législation et l'Administration Sanitaire en Italie et les Institutions Scientifiques annexées à la Direction de la Santé Publique*," which may be consulted in the Library of The Sanitary Institute.

A prolonged discussion took place on the prevention of Cholera, with special reference to recent experience in Italy. Dr. Bocci, Sanitary Medical Officer for the Province of Rome, described the success of the measures of isolation and disinfection by which the appearance of the cholera in the Province last year had been combatted. Only some 100 cases occurred altogether, and the disease never became epidemic. The precautions taken at the seaports were described by Dr. Paolo Merlo. Reliance was placed on medical inspection to detect suspicious cases of illness, and on disinfection of foul vessels and merchandise. All vessels, including those last from infected ports, were admitted freely, except ships crowded by passengers of the poorest class in a dirty condition. When a ship was found in this condition, disinfection was practised with particular care, and passengers were not allowed to land until after a detention of twelve to twenty-four hours, at the end of which time a second medical inspection was made to detect suspicious cases. Any vessel actually infected was sent to the disinfecting station at Asinara (an island off the coast of Sardinia), where the sick were taken to the lazaretto, the other passengers landed, and the ship and its contents thoroughly disinfected.

Professor Pagliani submitted an elaborate report on the whole subject. He sketched briefly the measures taken to prevent the introduction and the diffusion of cholera in Italy, and the behaviour of the epidemic in the various provinces attacked. He showed that the precautions had been everywhere efficacious.

The Section also considered the question raised by Mr. Coles and other English delegates, of "the necessity for the qualification of plumbers engaged in sanitary work." In the course of the discussion, Dr. Angelo Pavone pointed out that medical officers and sanitary inspectors were powerless to protect the public against the manifold evils and dangers to health arising from sewer and drain emanation, unless plumbers were duly qualified to carry out their work with sanitary efficiency. Finally, the suggestion that the Director of Public Health should take action to establish a registration of qualified plumbers in Rome and other cities in Italy was approved.

Dr. Leoni, Chief of the Italian Vaccine Establishment, already mentioned, described the working of that institution, and the precautions taken to ensure the purity of the lymph. These are of two orders. In the first place the healthiness of the calves used is enquired into with very great care, and no lymph is issued for use until after the calf has been killed and a *post mortem* examination made; if any ground for suspicion arises the organs of the animal are submitted to microscopical and bacteriological examination. As a matter of fact in only one instance out of 940 has a calf been found to be tuberculous. The second series of precautions are directed to prevent the accidental contamination of the lymph by microbes capable of causing suppuration, and are of the ordinary antiseptic type. The glycerine used for diluting the lymph is sterilised by heat. The lymph is preserved in small cylindrical glass vessels stoppered with glass and sealed with paraffin. It has been found that when freshly prepared in this manner the lymph contains nearly always various microbes, some of which are sometimes capable of producing suppuration. The lymph is stored in a special room, called the *frigidarium*, which is kept constantly at a temperature of about 58 F. After remaining here three or four weeks the pus-producing microbes disappear, or at least cease to be a source of danger. In accordance with this observation the lymph is only issued for use after it has been kept for at least three weeks, and is not generally preserved more than three months. Since the foundation of the Vaccine Establishment 9,094,602 have been vaccinated, and the proportion of successful vaccinations has been:—Primary, 97·30 per cent.; Secondary, 72·06 per cent.

Professor E. Liceaga, President of the Council of Hygiene of Mexico, contributed a description of the organisation of the Sanitary Service in that country. The States which combine to form the Mexican Confederation are free and independent, but the measures for preventing the entrance of epidemic disorders are in the jurisdiction of the Federal Executive. The Minister of the Interior is the chief executive officer. He is assisted by the Council of Hygiene, which has both consultative and executive powers, and is represented in the ports by special delegates. The Federation also has Sanitary Officers with each of the State Governments and at the principal points of ingress on the land frontier. In emergencies special Federal Commissioners may be nominated. On all Sanitary questions the last appeal is to the Federal Sanitary Code, and the rules and regulations drawn up in compliance with its provisions.

Professor Nosotti, Director of the Roman Abattoir, read a paper which contained some curious statistics as to the fluctuations in the quantity of meat consumed by the Roman population. The general conclusion which he drew was that the average daily consumption varied not in direct relation to the increase in the number of the inhabitants, but to their economic position. A comparison of the figures for the past decade showed that the daily consumption reached a maximum in 1887, and decreased at once when the economic crisis, which still exists, began to develop. A similar effect had, he observed, been noticed in Paris and Berlin.

The International Medical and Hygienic Exhibition was in several directions a very interesting collection. It was placed in the Palazzo de Belle Arti, a well-lighted building in a central situation, and overflowed into the neighbouring Eldorado. Germany was particularly well represented, not only by exhibits sent by manufacturers and booksellers, but also by maps, plans, models, and books sent by the Imperial Health Department, by the Prussian Ministry of War, and by Government Departments of many of the lesser States, as well as by the Municipality of Berlin. Some of the Italian municipalities were among the exhibitors, but the Italian exhibits were chiefly in the direction of mineral waters, though pharmaceutical products and some sanitary appliances were also shown. The cement floors and dados for hospital wards, operating rooms, and mortuaries exhibited by the firm of Vianini & Co., of Rome, were specially worthy of note for the excellence of the workmanship and the elegance of the colour effects obtained. Of British sanitary exhibits there were few.

An interesting collection of historical objects was brought together in one of the rooms. The Ministry of the Interior showed a fine series of manuscripts lent by various university and public libraries in Italy, some of the earliest coming from Bologna. Among the other objects exhibited in addition to manuscripts, books, statues, vases, medallions, coins, cameos, and seals, were specimens, models, and photographs of ancient surgical instruments.

The great prevalence of malarial disease is one of the most serious difficulties which stand in the way of the more rapid development of Italy. It is, directly or indirectly, one of the causes of the excessive emigration from certain provinces, it is responsible for a very considerable part of the high death-rate, and has a still larger share in producing the large amount of disabling sickness recorded in certain provinces. The extent of country affected by this scourge may be gathered from the calculation made recently by Professor Nitti, that 5,580 communes out of the total of 8,257, suffer more or less. The unhealthiness of the Campagna of Rome is notorious. Very numerous remedies have been suggested. During the last three centuries of its rule, the Papal Government applied various schemes, but all seem to have been founded upon the common assumption that the insalubrity of the Roman Campagna was a comparatively new thing, related in some way to the devastations of the barbarians. There is good reason, however, to believe that the Agro Romano was considered unhealthy during the summer months by the Romans of the late Republic and Empire. The Minister of Agriculture exhibited in the International Exhibition of Medicine and Hygiene, a series of maps of the Agro Romano. Two of these showed, the one, the nature of the soil and subsoil, the other, the various depths of soil suitable for cultivation. The soil, no where of great depth, rests on volcanic strata and is therefore liable to become water-logged. As many as 10,000 springs of water have been enumerated within ten kilometers of Rome. Much of the district is marshy or on the verge of marsh, and there are extensive salt marshes at the sea border. The natural drainage is altogether insufficient, and a first important step was taken to remedy this state of things by the law of December 11th, 1878. Under it the State undertook to drain the Marshes of Ostia, of Maccarese, and certain others, while the proprietors, who were grouped together in Syndicates to this end, were required to dig canals, and ditches to drain stagnant waters in to them. These works are not yet complete, but a great deal has been done both by the State and by the proprietors, and on the whole, the law of the Bonificamento Idraulico is being well carried out.

A second law, commonly called the Law of the Ten Kilometers was passed in 1883. It enacted that the proprietors of the Agro Romano within ten kilometers of the Forum should proceed at once to carry out planting and drainage, each on its own estate. Failure to comply with the law was to entail compulsory purchase by the State followed by sale in small parcels. The law has been obeyed on a few estates only, but the penalty has not been enforced. The works which have been carried out, however, have had a perceptible influence on the health of the inhabitants as was shown by the charts exhibited by the Minister of Agriculture, in which the sickness rates in 1888—90 were contrasted with those for 1891—93. Other maps showed that something has been done to improve the water supply, which is commonly much contaminated with vegetable matter and in some districts, especially on the left side of the Tiber, is inadequate in spite of the frequent marshy ground. The opinion that the prevalence of malaria may be associated with the use of the marshy water for drinking purposes has led to an attempt to supply mountain water to the farms. To this end thirty-five Kilometers of conduits have been laid down and the Acqua Marcia is now distributed from eleven central stations. In spite of the fact that experience has proved that the habitual use of this mountain water increases greatly the chance of escaping malaria, the greatest indifference has been shown by the persons interested and little more than a tenth part of the supply offered has been utilised.

In this connection reference may be made to the immense works for the canalisation of the Tiber which have been in progress for many years but are not yet complete. The great embankment on the left bank has advanced so far, however, that the low-lying parts of old Rome are now to a great extent protected from the disastrous floods by which they used to be devasted at irregular intervals. Professor Celli, during the Congress, took a large party over these works and also explained the improvements in the sewage system of the city which have been carried out or are in contemplation.

The Hygienic Institute of the University of Rome is under the direction of Professor Celli. It is a fine building which has been in part newly built and in part adapted to its purpose. It contains a large series of well-lighted laboratories as well as class rooms for students and a theatre. Among Prof. Celli's assistants and the workers in his laboratories are several gentlemen who hold teaching appointments in some of the smaller Universities where their attendance is only required for a few months in the year; several have been trained as to practical hygiene in England and as to bacteriology in Germany.

THE EIGHTH INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY.

To be Held at Budapest,

September 1st to 9th, 1894.

Patron :

His Imperial and Apostolic Royal Majesty.

Deputy-Patron :

His Imperial and Royal Highness Archduke Charles Louis.

The Eighth Congress of this Series will be held this year in Budapest, the invitation from Budapest having been accepted at the closing meeting of the Seventh Congress, which was held in London, in August, 1891.

The Congress will be opened by His Imperial and Royal Highness Archduke Charles Louis on September 2nd. On the opening day Dr. Ferdinand Hueppe will deliver an oration to the memory of the late Ignatius Semmelweis, at the close of which the members will proceed to the cemetery to be present at the unveiling of the tombstone erected over his grave.

The officials appointed are the following: President of the Congress, Count Stephen Karolyi; President of the Organizing Committee, Charles Kammermayer; President of the Executive Committee, Prof. Dr. Joseph Fodor; Hon. Secretary-General, Prof. Dr. Coloman Müller, The offices of the Congress are at the St. Rochus Hospital, Budapest.

The work of the Congress will be carried on in two divisions, viz., the Hygiene and Demography division.

In the Hygiene division there are nineteen sections, and in the Demography division seven sections, viz. :—

Hygiene.—Sec. I.: The Ætiology of Infectious Diseases (Bacteriology). Sec. II.: The Prophylaxis of Epidemics. Sec. III.: The Hygiene of the Tropics. Sec. IV.: The Hygiene of Trades and Agriculture. Sec. V.: The Hygiene of Children. Sec. VI.: The Hygiene of Schools. Sec. VII.: Articles of Food. Sec. VIII.: The Hygiene of Towns. Sec. IX.: The Hygiene of Public Buildings. Sec. X.: The Hygiene of Dwellings. Sec. XI.: The Hygiene of Communications (Railroads and Navigation). Sec. XII.: Military Hygiene. Sec. XIII.: Saving of Life. Sec. XIV.: State Hygiene. Sec. XV.: The Hygiene of Sport (Inurement and Care of the Body). Sec. XVI.: The Hygiene of Baths. Sec. XVII.: Veterinary. Sec. XVIII.: Pharmacology. Sec. XIX.: General Samaritan affairs.

Demography. — Sec. I.: Historical Demography. Sec.: II. General Demography and Antrophometry. Sec.: III. The Technic of Demography. Sec. IV.: The Demography of the Agricultural Classes. Sec. V.: The Industrial Labourers from the Demographic Point of View. Sec.: VI. The Demography of Towns. Sec.: VII. The Statistics of Bodily and Mental Defects.

Up to the 31st of March the Executive Committee had already received 437 papers for Division I. and 98 for Division II. The meetings of the Sections will be held on September 3rd, 4th, 5th, 7th and 8th, from 9 a.m. till 2 p.m. Thursday, September 6th, is reserved for short excursions.

International Committees have also been appointed to consider the question of Diphtheria, and this subject will be discussed on the second day of the Congress, at a combined meeting of the 1st, 2nd, and 3rd Sections.

The Congress will be closed on September 9th.

The fee of membership is: for a gentleman, 10 florins; and for a lady, five florins. The members paying 10 florins will also be entitled to receive one copy of the printed transactions of the Congress.

The following Excursions and Entertainments have also been arranged:—

A. The Corporation of Budapest, as the host of the members of the Congress, will arrange for their guests an Evening Party in the National Museum and Gardens, for the purpose of introducing the members to each other.

B. The Corporation will also arrange a Reception Soirée in honour of the members, in the Halls of the Town Redoute.

C. At the Royal Opera House, the National Theatre, and at the People's Theatre, festive representations will be given in honour of the members of the Congress.

D. September the 6th (Thursday) being reserved for a day of rest, the members will have an opportunity—

1. To view the public buildings, hospitals, establishments, sanitary institutes, factories, etc.
2. On this day the members may make excursions
    - *a.* to Totis, the seat of Count Nicolas Eszterházy, who invites them there;
    - *b.* or to Balatonfüred;
    - *c.* or to Siófok on the Plattensee;
    - *d.* or to the Heights of Buda;
    - *e.* or to the Margarethen Island, where the XV. Section (Sport, etc.) will arrange a Regatta, etc.

E. On two evenings the Section of Sports arranges Athletic, Gymnastic, and Cycling Competitions.

F. The Corporations and Societies interested in the Congress will also arrange Reception Soirées in honour of the members.

G. On the other evenings the Hungarian Presidents and Honorary Presidents will entertain the members.

H. After the closing of the Congress the following great Excursions are contemplated:—

1. Excursion to Belgrad, Constantinople.
2. „ Belgrad, Hercules, Bath.
3. „ Mezöhegyes, the Hungarian State Farm for Horse and Cattle-breeding.
4. „ the High-Tátra, Old and New-Tátrafüred, and to the Ice Cave of Dobsina (in connection with a skating festival).
5. „ Agram, Fiume, Abazzia.
6. „ Bosnia and the Herzegovina.
7. „ Pistyán.

Full information concerning the several Excursions proposed, will be given in detail later.

Ladies' Committee.

For the reception, conducting, and entertaining of the lady members of the Congress, a Special Committee has been formed, the Presidency of which Mrs. Polixena Pulszky-Hampel has been kind enough to accept.

A Committee has been formed in England to further the interests of the Congress in this country. Sir Douglas Galton, K.C.B., F.R.S., is the Chairman, and Prof. W. H. Corfield, M.A., M.D.(Oxon.), is the Treasurer of this Committee. Dr. Paul F. Moline, 42, Walton Street, Chelsea, is the Hon. Secretary, from whom information and programmes concerning the Congress may be obtained. The agents of the Congress, Messrs. Thos. Cook & Son, Ludgate Circus, E.C., will supply information as regards travelling, railway fares, etc., and will secure accommodation in Budapest if desired.

A CONTRIBUTION TO A BIBLIOGRAPHY OF HYGIENE.

PART II.

BY G. J. SYMONS, F.R.S.

I have considered carefully the opinions which have been expressed as to the utility of the contribution to the above subject which I prepared for the last number of this Journal, and the Secretary has placed in my hands certain papers received by the Institute. I think that a few prefatory words are desirable before proceeding to give a short supplementary list of books, and the list of periodicals, which I promised.

The only misunderstanding which seems to have arisen is that some persons have overlooked the first three words of the title of my paper, "*A Contribution to* a Bibliography of Hygiene." To provide a work worthy of the last four words would be task entirely beyond my power—it would take a year or two to prepare the MS., and probably five or six issues of the Journal to contain it if printed. My object was the much humbler one of giving the titles of a few hundred books which (as far as I was acquainted with them) would form a good working library for a Sanitarian, and which list would be what I called it, "A Contribution to a Bibliography of Hygiene."

Ample proof of the wisdom of my modest title is afforded by a very remarkable catalogue recently issued by Herr F. Pietzcker, of Tubingen, perhaps the largest dealer in the world in new and second-hand medical books. Pietzcker's Catalogue, No. 200, consists of 110 8vo. pages, contains 3,937 entries classified with great care, and yet is wholly devoted to Hygiene. Was I not justified in saying that to compile a Bibliography of Hygiene would be an almost Herculean task? I need say no more respecting this important catalogue, except that I trust that Herr Pietzcker may be adequately rewarded for his labour in collecting the works and cataloguing them. But what a library it would have been, to have bought *en bloc.*

I pass next to the only other matter calling for special notice, viz., a MS. of about 13 pages foolscap, entitled "Addenda to the Bibliography of Hygiene," and very kindly forwarded by Mr. H. Gilbert Whyatt, Assoc.M.Inst.C.E., and now, I am glad to say, Member San. Inst.

Few things are more irritating or cause more loss of time than searching through two alphabetical lists when one would have sufficed. I have a list almost entirely of new works which ought to be brought to the notice of the readers of this Journal, but for the reason just given I feel sure that it will be best for those works in Mr. Whyatt's addenda which come within our scope, and my supplementary list to be united.

Abel, L. Das gesunde, behagliche u. bilige Wohnen. Wien, 1894. Mit 79 Abb. 10/-

Allsop, R. O. Public Baths and Wash-Houses. 104 pp., 8vo. Illustrated with Plans and Sections. 6/- London, 1894.

Arens, C. Quantitative Staubbestimmungen in der Luft nebst Beschreib. eines neuen Staubfängers. Würzb., 1894. Mit Abb. 1/6

Assmann, R. (*See* Weyl.)

Bayles, Jas. C. House Drainage and Water Service in Cities, Villages and Rural Neighbourhoods, with incidental consideration of causes affecting the healthfulness of dwellings. 8vo. London. 15/-

Beardmore, W. Lee, *Assoc.M.Inst.C.E.* The Drainage of Habitable Dwellings. London, 1893. 5/-

***Billings, John S.,** *M.D., LL.D., Surgeon U.S. Army.* Principles of Ventilation and Heating. London, 1893.

Boecker, F. W. Lehrbuch der gerichtlichen Medicin. 2. Auf. Mit Hlzschn. Iserlohn, 1857. 2/-

Boulnois, H. Percy, *M.Inst.C.E.* Disposal of Town's Refuse. 16mo. London, 1893. -/6

Bowler, W., *Agriculturist,* and **Newton, John,** *C.E.* Disposal of Town's Sewage and Refuse. 1. Advantages of the Dry System (Bowler); 2. Advantages of the Water Carriage System (Newton). 16mo. Manchester, 1892. -/6

***Buckle, Dr. Fleetwood.** Vital and Economical Statistics of the Hospitals, Infirmaries, &c., of England and Wales. 78pp., 8vo. London, 1865. 5/-

Buesing, F. W. (*See* Weyl, T.)

***Burke, Ulick Ralph.** A Handbook of Sewage Utilization. 2nd Edit., enlarged. 8vo. London, 1873. 3/6

***Burn, R. Scott.** Utilization of Sewage, Irrigation, and Reclamation, of Waste Lands. 8vo. London. 2/6.

*——— Practical Ventilation. 8vo. 1850.

Butler, W. F. The Ventilation of Buildings. 8vo. London, 1873. 1/-

Cameron, J. Spottiswoode, *M.D., M.O.H. Leeds.* Is my house healthy? How to find out. Leeds, 1893.

***Clarke, J. Wright.** Plumbing Practice. 356 pp., 8vo. London, 1893. 6/-

*——— Tables for Plumbers, Architects, Sanitary Engineers. 64mo., 217 pp. London, 1893. 1/6

Constantine, Joseph. Practical Ventilation and Warming. With Illustrations and Examples, and suggestions on the Construction and Heating, &c., of Disinfecting Rooms and Turkish Baths. 160 pp., 8vo. 52 Illustrations. London, 1881. 6/-

Davies, P. J. Standard Practical Plumbing. 8vo. London, 1882. 7/6

---

* In Library of the Institute.

Davis, Geo. F. and **Alfred R.**, *Engineers.* The River Irwell and its Tributaries: a monograph on River Pollution. 8vo. Manchester, 1890. 2/6

Dempsey, G. D. Rudimentary Treatise on the Drainage of Districts and Lands. 160 pp., 12mo. London, 1849. 1/6

*——— Rudimentary Treatise on the Drainage and Sewerage of Towns and Buildings. 3rd Edition. 176 pp., 12mo. London, 1865. 2/6

Denton, E. F. Bailey. Sanitary Engineering. A Handbook on House Sanitation, for the use of all persons seeking a Healthy Home. London, 1882. 8/6

——— The Domestic Filtration of Water. 8vo. London. -/6

Denton, J. Bailey, *M.Inst.C.E., F.G.S.* Intermittent Downward Filtration *per se*, and in Conjunction with Surface Irrigation. 8vo. London, 1880. 1/-

——— Sanitary Works and Sewage Utilization. 8vo. London, 1869. 1/-

***Dukes, C.** Health at School. 3rd Edition, revised, enlarged, and illustrated. 1894. 9/-

Ellis, Havelock. Nationalisation of Health. Treatment of Disease, Hospital of the future, Poor Law Infirmaries, Typhoid Fever, Blindness and Short-Sight, Maternity and its perils, Registration of Disease, &c., &c. 8vo. London, 1892. 3/6

Fitzau, H. Uber den Einfluss der Würzburger Schwemmkanalisation auf den Main. Würzb, 1893. 1/-

Gautrez, E. Hygiène des vacheries et la réglementation du commerce du lait. Paris, 1894. 3/6

Goldberg, B. Der Einfluss des Witterungsganges auf vorherrschende Krankheiten u. Todesursachen. Bonn, 1893. 1/-

Hart, Jno. W., *R.P.C.* Hints to Plumbers. London, 1893.

Hinnell, H. Leonard, *Assoc.M.Inst.C.E.* Sewage Treatment. 42 pp. Bolton, 1891. 1/-

***Jenkin, Prof. Fleeming,** *F.R.S.* Healthy Houses. Three Lectures: 1. Healthy Houses; 2. Ventilation and Warming; 3. On Sanitary Inspection. 8vo. 66 pp. Edinburgh, 1878. 2/6

Jolles, A. Das Margarin, seine Verdaulichkeit u. sein Nährwerth im Vergleich zur reinen Kunstbutter. Wien, 1894. -/6

Kratschmer, F. (*See* Weyl.)

Leeds, L. W. A Treatise on Ventilation, shewing the great want of Improved Methods of Ventilation, &c. 8vo. New York, 1871. 10/6

Leigh, John, *M.D.* Coal Smoke; its Nature and Suggestions for its Abatement. 8vo. Manchester, 1883.

Lomax, Chas. J. Collection, Treatment, and Disposal of Town Refuse. 1892.

***London County Council.** Report on Dust Destructors. By Dr. W. H. Hamer and W. Santo Crimp, *M.Inst.C.E.* 16 pp., f.cap. London, 1893. *Out of Print.* -/6

---

* In Library of the Institute.

Low, Sampson, Jr., *B.A.* Sanitary Suggestions, or the Householder's Vade Mecum. London, 1893.

***Lumley's Edition of Public Health Act, 1893.**

Macdonald, John D., *M.D.*, *F.R.S.* A Guide to the Microscopical Examination of Drinking Water. With an Appendix on the Microscopical Examination of Air. 8vo., 25 Plates. London, 1883. 7/6

Millington, F. H. The Housing of the Poor. Owen's College, Manchester, Warburton Prize Essay, 1890. 104 pp., 12mo. London, 1891. 1/-

Monson, Edward, *A.I.C.E.* The Advantages of the Separate System of Drainage. 8vo. London, 1875. 1/-

***Moore, Col.**, *R.E.* Papers on Sanitary Engineering. Chatham, R.E.Inst., 1894.

Moore, Sir William J., *K.C.I.E.*, *M.D.* Health in the Tropics; or Sanitary Art applied to Europeans in India. 318 pp., 8vo. London, 1862. 9/-

Newton, John, *C.E.* (*See* Bowler.)

***Nichols, Wm. Ripley.** On the Filtration of Potable Water. 8vo. London, 7/6

Nightingale, Florence. Health Teaching in Towns and Villeges: Rural Hygiene. 8vo. London, 1894. -/6

Nossig, A. Die Sozial-Hygiene der Juden u. des altoriental. Völkerkreises. Stuttg., 1894. 4/-

——— Einführung in das Studium der sozialen Hygiene. Stuttg, 1894. 6/-

Oppert, Francis, *M.D.* Hospitals, Infirmaries, and Dispensaries: their Construction, Interior Arrangement, and Management; with Descriptions of existing Institutions. 278 pp. 74 Illustrations. 8vo. London, 1883. 12/-

Osthoff, G. (*See* Weyl.)

Philbrick, Ed. S., *C.E.* American Sanitary Engineering. 8vo. London. 10/6

Putnam, J. P. Improved Plumbing Appliances. 8vo. 94 Illustrations. London. 6/-

Rafter, Geo. W., *C.E.* Mechanics of Ventilation. 18mo. Lond. 2/-

Railton, T. C., *M.D.*, *L.R.C.P.* The conditions required for a healthy house. 8vo. 1889.

Reger. Graphische Darstellungen der Weiterverbreitung verschiedener contagiöser Infectionskrankheiten. Wiesb., 1893. Mit 2 Tfln. 1/-

Reich, E. Die Hygiene der Studium u. Ausübung. Würzb., 1874. 3/-

***Reid, Dr. D. B.**, *F.R.S.E.* Examples of Ventilation, with remarks on Warming, Lighting, and the Communication of Sound. 451 pp., 8vo. Illustrated. London, 1844. 16/-

Reincke, J. J. Die Cholera in Hamburg u. ihre Beziehungen zum Wasser. Hamb., 1894. Mit 5 Abb. u. 7 Tfln. 6/-

---

* In Library of the Institute.

Sanger, G. Hurst, *C.E.* House Sanitation. 8vo. Illustrated. London. 1/-

Schellong, O. (*See* Weyl.)

Schultze, R. (*See* Weyl.)

Slater, J. W., Sewage Treatment, Purification, and Utilization. A Practical Manual. Illustrated. London, 1893. 6/-

Smith, Adolphe, *F.C.S.* Pneumatic Drainage, a description of the "Berlier System." 8vo. Illustrated. London, 1883. 1/-

***Snell, H. Saxon,** *F.R.I.B.A.* Charitable and Parochial Establishments. 70 pp., Imp.4to. London, 1881. £3 3/-

Spon, Ernest, *Assoc.M.Inst.C.E.* The modern practice of sinking and boring Wells, with geological considerations and examples of Wells. 8vo. London, 1875. 10/6

***Stocker, J. S.,** *M.D.* Hints for Health, being Two Lectures on the Influence of Air, Water, &c., on the system. 47pp., 8vo. London, 1874. 2/-

Stutzer, A. (*See* Weyl.)

Taylor, E. Brough, *M.Inst.C.E.*, and **Taylor, G. Midgley,** *Assoc.M.Inst.C.E.* Waterpipe Discharge Diagrams: shewing the Relation between the Diameters, Gradients, Discharges, &c. obg. folio. 14 diagrams. Batsford, London, 1891. 12/6

***Teale, T. Pridgin,** *M.A.*, *F.R.S.* Dangers to Health: A pictorial guide to Domestic Sanitary Defects. 4th Edition. 172 pp., 8vo. 70 Plates (mostly coloured). London, 1883. 10/-

***Tomlinson, C.,** *F.R.S.* Rudimentary Treatise on Warming and Ventilation. 339 pp., 12mo. London, 1878. 3/-

Trouillet, Auguste. Hygiène des lycées, étude faite au lycée Saint-Louis. 8vo. Paris, 1891. 2/-

***Turner, Ernest,** *F.R.I.B.A.* Hints to House Hunters and House Holders. Prepared at the request of the National Health Society. 8vo. London, 1883. 2/6

***Vacher, F.,** *F.R.C.S.* Defects in Plumbing and Drainage Work. 90 pp., 8vo. Illustrated by upwards of 100 Woodcuts. Manchester, 1894. 1/-

Warner, Wm., *Assoc.M.Inst.C.E.* Disposal of Refuse. A paper read before the British Association. 24pp., 8vo. Nottingham, 1893. 1/-

Watson, Sir T. The Abolition of Zymotic Diseases, etc. 8vo. 1879. 1/6

Weyl, Th. Handbuch d. Hygiene.

5. Anlagen f. die Versorgung der Städte m. Lebensmitteln. Markthallen, Schlachthöfe u. Viehmärkte. D. Geo. Osthoff. 8vo. Jena. 2/-
6. Volks—u. Hausbäder. R. Schultze.
   Die Sicherheit in Theatern u. in grösseran Versammlungs. Räumen. F. W. Büsing. 8vo. Jena. 2/-
7. Das Klima. R. Assmann.
   Akklimatisation u. Tropenhygiene. O. Schellong. 8vo. Jena. 2/6

---

* In Library of the Institute.

8. Nahrungs u. Genussmittel. A. Stutzer. 8vo. Jena. 5/-
9. Die Bekleidg. F. Kratschmer. 8vo. Jena. 2/-

***Wharam, R. M.** Sanitary Fittings and their Application. 8vo. London, 1891.

Whiley, Henry. Work and Cost of the Manchester Corporation Health Department. Manchester Statistical Society's Papers. *cir.*, 1882. *Out of print.* 3d.

PERIODICALS.

BRITISH ISLES.

***Journal** of the Sanitary Institute (quarterly). 2/6
***Public** Health (monthly). 10/6 per annum.
***Sanitary** Engineer (weekly). 2d.
Sanitary Journal, Glasgow (monthly). 6/- per annum.
***Sanitary** Record (weekly). 3d.

BELGIUM.

Le Mouvement Hygiénique (monthly). 8/- per annum.

FRANCE.

Annales d'Hygiène Publique et de Médecine Légale (monthly).
***Journal** d'Hygiene (weekly).
L'Hygiène Pratique (weekly).
Revue d'Hygiène et de Police Sanitaire. Red. E. Vallin, Paris (monthly).

GERMANY.

Archiv f. Hygiene, hrsg. v. Forster, Hofmann u. v. Pettenkofer. München (quarterly). 15/- per ann.
Centralblatt f. allg. Gesundheitspflege, hrsg. v. Finkelnburg, Lent u. Wolffberg (monthly). Bonn. 10/-
Friedreich's Blätter für gerichtliche Medicin u. Sanitätspolizei, hrsg. von O. Messerer (monthly). Nürnb. 10/- per ann.
Gesundheits Ingenieur, Munich (monthly).
Gesundheit. Zeitschr. f. öffentl. u. priv. Hygiene, hrsg. v. Ruff. Frankfort (fortnightly). 16/- per ann.
Hygieia, hrsg. von Niemeyer und Gerster (monthly). 7/6 per ann.
Hygienische Rundschau, hrsg. v. C. Fränkel, Rubner, Thierfelder. 14/-
***Journal** für Gesundheitspflege, hrsg. v. Bisenz. Leipsig. 6/-
Monatsblatt für öffentl. Gesundheitspflege, hrsg. v. Blasius (monthly). 4/- per ann.
Veroeffentlichungen d. kaiserl. deutsch. Gesundheitsamtes (weekly). Berlin. 10/- per ann.
***Vierteljahrsschrift,** Deutsche, für öffentl. Gesundheitspflege, hrgs. v. Spiess u. Pistor (quarterly, with a supplement). About 5/- each part.

---

* In Library of the Institute.

Vierteljahrsschrift, Deutsche, für gerichtl. Medicin u. öffentl. Sanitätswesen, hrsg. v. Eulenberg (quarterly). Berlin. 14/- per ann.

Zeitschrift f. Erziehg. u. Unterricht. Familienblatt f. hygien. Aufklärg., f. Naturheilkunde u. e. natürl. Lebensweise, hrsg. M. Schmidtbauer (monthly). 3/6 per ann.

——— für Fleisch- und Milch-Hygiene, hrsg. v. Ostertag (monthly). 8/- per ann.

——— für Heilkunde, hrsg. v. Hasner u. A. (bi-monthly). Prag. 20/- per ann.

——— für Hygiene, hrsg. v. Koch u. Flügge (quarterly). About 6/- each part.

——— für Nahrungsmitteluntersuchung u. Hygiene, hrsg. v. Heger (monthly). 6/- per ann.

——— für Schulgesundheitspflege, hrsg. v. Kotelmann (monthly). 8/- per ann.

INDIA.

Journal of the Health Society for Calcutta (monthly). 5/- per ann.

ITALY.

La Salute Italiana Medica, Genoa (weekly). 8/- per ann.

La Salute Publica, Perugia (monthly).

***Rome.** Giornale della Reale Società Italiana d'Igiene. 8vo. (monthly).

Rivista Internazionale d'Igiene. Dir. E. Fazio. Naples (monthly). 12/- per annum.

PORTUGAL.

Lisboa. Boletim Hebdomadario de Estatistica Demographica e Medica (weekly).

SPAIN.

La Higiene. Madrid (weekly).

Revista de la Sociedad Española de Higiene.

Boletin de Sanitad. 8vo. Madrid.

SWITZERLAND.

Societe d'Hygiène de Genève, Publications de la.

Wochenbulletin Sanitarisch-demograph., d. Schweiz.—Bulletin démographique et sanitaire suisse, hrsg. vom schweizer. Gesundheitsamt u. eidgenöss. statist. Bureau (weekly). 5/- per ann.

Schweizerische Blätter für Gesundheitspflege. Redaktion, Dr. G. Custer. 8vo. (fortnightly).

UNITED STATES.

Sanitary Engineer. New York (weekly).

Technology Quarterly, and Proceedings of Society of Arts, Massachussetts.

***The Sanitarian.** New York (monthly).

---

* In Library of the Institute.

HYDRAULIC FORMULÆ.

By HENRY LAW, M.Inst.C.E.

Discharge over Weirs.—In the case of rectangular weirs, that is weirs having a level sill and sharp edges, let q = the quantity of water discharged in cubic feet per minute, c = co-efficient from the table given below, b = breadth of weir, w = width of the stream, and h = the head of water above the sill of the weir, measured some distance above the same, all in feet; then

$$q = c\,b\,\sqrt{h^3}$$

When $b = w$, that is when the weir occupies the whole width of the stream, $c = 214$; the values of c, when b is less than w, are given in the table below namely:

Values of $\frac{b}{w}$	1·0	0·9	0·8	0·7	0·6	0·5	0·4	0·3	0·25
Values of c	214·0	211·0	208·0	204·4	201·5	198·5	194·9	191·9	190·1

The above formula supposes the water to flow over the weir from a still pond, but if the water approaches the weir with a velocity = v feet per second, let $h_1 = 0{\cdot}01553\,v^2$; then

$$q = c\,b \left\{ \sqrt{(h + h_1)^3} - \sqrt{h_1^3} \right\}$$

In the case of a drowned weir, let h_2 = the height of the surface of the water below the weir above the sill of the weir in feet; then

$$q = c\,b \left(h + \frac{h_2}{2}\right) \sqrt{h - h_2}$$

Triangular notches are sometimes used for gauging small streams; if the angle made by the two sides of the notch is 90°, let h_3 = the height in inches of the surface of the water above the apex of the notch, the notch being sharp-edged, and the pond still; then

$$q = 0{\cdot}306\,\sqrt{h_3^5}$$

Discharge through apertures in the bottom or sides of vessels.—Let a = the area of the aperture in square feet, h = the height in feet of the surface of the water above the centre of gravity of the apertures, and q = the discharge in cubic feet per second; then

$$q = 7a\,\sqrt{h}$$

Discharge through pipes.—Let d = diameter in inches, l = length of pipe in feet, h = the head in feet, and q = the discharge in cubic feet per minute; then

$$d = 0{\cdot}5408 \sqrt[5]{\frac{q^2 (l + 4{\cdot}2\, d)}{h}}$$

$$q = 4{\cdot}7233 \sqrt{\frac{h\, d^5}{l + 4{\cdot}2\, d}}$$

$$l = 22{\cdot}31 \frac{h\, d^5}{q^2}$$

$$h = 0{\cdot}04482 \frac{q^2 (l + 4{\cdot}2\, d)}{d^5}$$

Resistance of Bends.—Let R = the radius of the centre line of the bend, r = the radius of the pipe, v = the velocity in feet per second through the pipe, c = a variable co-efficient, n = the number of degrees that the pipe changes its direction, and h = the head in feet required to overcome the resistance of the bend; then

$$h = c\, n\, v^2$$

In circular pipes,

$$c = {\cdot}000011304 + {\cdot}00015938 \left(\frac{r}{R}\right)^{\frac{7}{2}}$$

And in square pipes,

$$c = {\cdot}0000107 + {\cdot}00026786 \left(\frac{r}{R}\right)^{\frac{7}{2}}$$

Power required to pump through Mains.—Let P = horse power required, l = length of main in feet, q = quantity of water in cubic feet per minute, and d = diameter of main in inches; then

$$P = {\cdot}00009688 \frac{q^3\, l}{d^5}$$

Flow through a Channel.—Let v = velocity in feet per minute, q = discharge in cubic feet per minute, a = area filled in square feet, p = wetted perimeter in feet, and l = the length in which the channel falls 1; then

$$v = 5651{\cdot}9 \sqrt{\frac{a}{pl}}$$

$$q = 5651{\cdot}9 \sqrt{\frac{a^3}{pl}}$$

Kutter's formula for flow through a Channel.—Let v = velocity in feet per second, d = hydraulic mean depth in feet,

l = length in which channel falls 1, and n = a variable co-efficient; then

$$v\ c = \sqrt{\frac{d}{l}}$$

in which

$$c = \frac{y}{1 + \frac{x}{\sqrt{d}}}$$

in which

$$y = 41{\cdot}6605 + {\cdot}0028076\ l + \frac{1{\cdot}81133}{n}$$

$$x = (41{\cdot}6605 + {\cdot}0028076\ l)\ n$$

n varies in value from ·010 in the case of glazed pipes with perfect joints, to ·015 for rough brickwork with open joints.

Surface, mean, and bottom velocities.—Let v_1 = the surface velocity in the middle of the stream, v_2 = the mean velocity, and v_3 = the bottom velocity of a stream, all in inches per second: then

$$v_3 = (\sqrt{v_1} - 1)^2 = v_1 - 2\sqrt{v_1} + 1$$

$$v_2 = 0{\cdot}8\ v_1$$

To reduce these values to feet per minute, multiply by 5, and to miles per hour, multiply by ·05682.

Flow through Circular Sewers.—Let a = the sectional area in square feet of the portion of the sewer filled, p = the wetted perimeter in feet, d = the diameter in feet, l = the length in which the sewer falls 1, δ = the hydraulic mean depth in feet, v = the velocity in feet per minute through the sewer, and q = the quantity discharged in cubic feet per minute; then

$$\delta = \frac{a}{p}$$

$$d = \frac{v^2\ l}{c^2} = \sqrt[5]{\frac{q^2\ l}{s^2}}$$

$$l = \frac{d\ c^2}{v^2} = \frac{d^5\ s^2}{q^2}$$

$$v = c\sqrt{\frac{d}{l}}$$

$$q = s\sqrt{\frac{d^5}{l}}$$

$$c = v\sqrt{\frac{l}{d}}$$

$$s = q\sqrt{\frac{l}{d^5}}$$

The first and last columns of the following table contain the number of hundredths of the whole diameter to which the sewer is filled, and the corresponding values of p, a, c and s are respectively found in the other columns.

Height to which filled.	Wetted perimeter $=p\,d$	Area filled $=a\,d^2$	Velocity $=c\sqrt{\frac{d}{l}}$	Logarithm of c.	Discharge $=s\sqrt{\frac{d^5}{l}}$	Logarithm of s.	Height to which filled.
	Value of p.	Value of a.	Value of c.		Value of s.		
·05	·45103	·01468	1019·8	3·008498	14·93	1·175313	·05
·10	·64350	·04088	1424·4	3·153650	58·22	1·765107	·10
·15	·79540	·07388	1722·5	3·236151	127·25	2·104648	·15
·20	·92730	·11182	1962·7	3·292853	219·48	2·341388	·20
·25	1·04720	·15355	2164·2	3·335299	332·31	2·521538	·25
·30	1·15928	·19817	2336·8	3·368617	463·07	2·665651	·30
·35	1·26610	·24498	2486·1	3·395525	609·05	2·784656	·35
·40	1·36944	·29337	2616·0	3·417631	767·44	2·885047	·40
·45	1·47063	·34278	2728·7	3·435952	935·34	2·970970	·45
·50	1·57080	·39270	2825·9	3·451165	1109·7	3·045224	·50
·55	1·67096	·44262	2908·9	3·463725	1287·5	3·109752	·55
·60	1·77215	·49203	2978·1	3·473939	1465·3	3·165928	·60
·65	1·87549	·54042	3033·9	3·482002	1639·6	3·214732	·65
·70	1·98231	·58723	3076·2	3·488012	1806·4	3·256821	·70
·75	2·09440	·63185	3104·4	3·491983	1961·6	3·292599	·75
·80	2·21430	·67357	3117·2	3·493769	2099·7	3·322154	·80
·85	2·34619	·71152	3112·5	3·493105	2214·6	3·345293	·85
·90	2·49810	·74452	3085·5	3·489329	2297·2	3·361207	·90
·95	2·69056	·77072	3025·0	3·480720	2331·4	3·367614	·95
1·00	3·14159	·78539	2825·9	3·451165	2219·5	3·346254	1·00

Flow through Oval Sewers.—By an oval sewer is here understood a sewer in which the width is two-thirds of the height, and in which the radii of the sides, the crown, and the invert are respectively 6, 2 and 1. Let h = the height of the sewer in feet, and the other letters have the same value as before; then

$$h = \frac{v^2\,l}{e^2} = \sqrt[5]{\frac{q^2\,l}{k^2}}$$

$$l = \frac{h\,e^2}{v^2} = \frac{h^5\,k^2}{q^2}$$

$$v = e\,\sqrt{\frac{h}{l}}$$

$$q = k \sqrt{\frac{h^5}{l}}$$

$$e = v \sqrt{\frac{l}{h}}$$

$$k = q \sqrt{\frac{l}{h^5}}$$

The first and last columns of the following table contain the number of hundredths of the whole height to which the sewer is filled, and the corresponding values of p, a, e and k are respectively found in the other columns.

Height to which filled.	Wetted perimeter $= p\,h$	Area filled $= a\,h^2$	Velocity $= e\sqrt{\frac{h}{l}}$	Logarithm of e.	Discharge $= k\sqrt{\frac{h^5}{l}}$	Logarithm of k.	Height to which filled.
	Value of p.	Value of a.	Value of e.		Value of k.		
·05	·26513	·00821	994·5	2·997589	8·16	0·911842	·05
·10	·39119	·02212	1344·1	3·128419	29·73	1·473257	·10
·15	·51019	·03950	1572·6	3·196614	62·11	1·793188	·15
·20	·62506	·05989	1749·5	3·242924	104·79	2·020306	·20
·25	·73655	·08293	1896·5	3·277951	157·28	2·196667	·25
·30	·84525	·10826	2022·7	3·305938	218·98	2·340413	·30
.35	·95167	·13556	2133·2	3·329024	289·18	2·461170	·35
·40	1·05624	·16454	2230·8	3·348462	367·08	2.564759	·40
·45	1·15930	·19490	2317·4	3·364999	451·65	2·654805	·45
·50	1·26121	·22636	2394·4	3·379206	542·02	2·734014	·50
·55	1·36224	·25868	2462·9	3·391448	637·10	2·804208	·55
·60	1·46267	·29158	2523·5	3·402000	735·80	2·866758	·60
·65	1·56277	·32482	2576·7	3·411066	836·96	2·922704	·65
·70	1·66288	·35811	2622·8	3·418773	939·27	2·972790	·70
·75	1·76456	·39090	2660·2	3·424908	1039·9	3·016971	·75
·80	1·87045	·42238	2685·8	3·429076	1134·4	3·054783	·80
·85	1·98434	·45167	2696·5	3·430797	1217·9	3·085619	·85
·90	2·11303	·47762	2687·1	3·429285	1283·4	3·108371	·90
·95	2·27343	·49856	2646·8	3·422715	1319·6	3·120436	·95
1·00	2·64330	·51046	2483·7	3·395102	1267·8	3·103062	1·00

Variable flow of Sewage.—Let q = the total quantity of sewage discharged in twenty-four hours in dry weather, f_1 = the maximum flow about noon, and f_2 = the minimum flow about 3 o'clock in the morning; then

$$f_1 = ·0017\,q$$
$$f_2 = ·00027\,q$$

the values of these co-efficients will somewhat vary according to circumstances.

Rainfall.—Let c = the depth of rain in inches, d = the cubic feet per acre, e = the cubic feet per square yard, a = the rainfall in inches in twenty-four hours, f = the rainfall in inches per hour, b = the cubic feet per minute per acre, and g = the cubic feet per minute per square yard; then

$$d = 3630\,c$$
$$e = 0{\cdot}75\,c$$
$$b = 2{\cdot}52\,a$$
$$g = {\cdot}0125\,f$$

Flood discharges.—Let q = quantity discharged in cubic feet per second, a = area of catchment basin in acres, and n = a variable co-efficient; then

$$q = \frac{n\,a}{\sqrt[3]{a+1}}$$

n will vary from two for the Fen districts to six for steep rocky districts.

Pressure of Water.—Let a = area of surface in square feet, d = the depth in feet of the centre of gravity of the same below the surface of the water, and p = the pressure in pounds; then

$$p = 62{\cdot}5\,a\,d$$

if h = the height in feet of a column of water, the pressure in pounds per square inch will equal 0·434 h.

NOTES ON LEGISLATION AND LAW CASES.

Prepared by Prof. A. Wynter Blyth.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Before Lords Justices Lindley, Davey and Smith.

(*L. T.* Rep., n. s. Vol. lxx., 206.)

OLIVER *v.* HORSHAM LOCAL BOARD. THOMPSON *v.* MAYOR AND CORPORATION OF BRIGHTON.

No action is maintainable for defects in the highway against a Local Authority, and if by reason of a defect in the highway a sewer grating causes an accident, the fact that the Local Authority has charge of both highways and sewers does not render them liable.

In Oliver *v.* Horsham Local Board, the plaintiff's daughter was riding on horseback; the horse struck its foot against a sewer grating, fell and was injured. The grating was properly inserted but the roads round the grating had worn away and in consequence the grating projected above the road. The circumstances were similar in the case of Thompson *v.* Corporation of Brighton, but in this case it was not a sewer grating but a manhole, the cover of which by reason of the road having been worn away projected an inch and a half above the level of the road.

The judgment of Lord Justice Smith sufficiently sets forth the state of the law on this subject, which Lord Justice Lindley considers very unsatisfactory.

Lord Justice Smith: The question in these appeals is whether a Local Authority who by statute have vested in them the highways in their district, together with their control, and are also in like manner empowered to lay down sewers in such highways, with the necessary manholes and gratings, can keep the two in combination (*i.e.* the highways and gratings) in such a condition as to cause injury to persons lawfully using the highway and yet not be liable to an action for damages at the suit of the persons injured, I take it that the answer off hand would be "No." But when the facts of these cases are applied to principles long since established, the answer must be "Yes." . . . . It has been held for at any rate over 100 years, dating from the case of Russell *v.* Men of Devon (2 Term Rep. 667), that no action for damages will lie against a surveyor of highways for injuries received by reason of a highway being out of repair. It is now beyond doubt the law, that where a person though lawfully using a highway is damaged, either as regards himself, his horse, or his carriage, merely by reason of the non-repair of a highway he has no action at law against anyone. His sole remedy is by indictment against the parish which has made default, or he may proceed against the surveyor under Sect. 94 of the Highway Act, for penalties. Damages he can recover against no one if his injury be caused by reason of mere non-repair. In the year 1870 it had been held by the Court of Queen's Bench in Gibson *v.* Mayor of Preston that a Local Authority who were constituted surveyors of the highways by the Public Health Act of 1848, had the same immunity from actions for damages as a surveyor of highways, and last year the House of Lords in Cowley *v.* Newmarket Local Board affirmed Gibson *v.* Preston, and conclusively settled that no action for damages will lie against any Local Board for merely allowing their highways to get out of repair. After the decision of *Gibson* v. *The Mayor of Preston* and before the decision of *Cowley* v. *Newmarket Local Board* the case of *Kent* v. *Worthing Local Board* came for determination in 1882. In that case the local board were what I will for brevity call the water authority and also the highway authority. The valve cover in that case had been lawfully placed by them in the highway: it was proper in itself, was originally properly fixed, and at the time of the accident was in proper order, but the Local Board had omitted to repair the road adjacent to the valve cover, so that it projected up into the highway, and hence the accident. Justices Field and Stephen held the defendants liable, relying upon the principle stated by the Privy Council in *Borough of Bathurst* v. *Macpherson*, viz., "that the duty was cast upon them (the Borough of Bathurst) of keeping the artificial work which they had created in such a state as to prevent its causing a danger to passengers on the highway, which but for such artificial construction would not have existed, or at the least of protecting the public against the danger when it arose, either by filling up the hole or fencing it." If the case of *Kent* v. *Worthing Local Board* had remained unchallenged there can be no doubt that the judgments of the County Court Judge are correct. It was however to say the least most seriously impeached in this court in the case of Moore *v.* The Lambeth Waterworks Co. It was there pointed out that in the case of *Borough of Bathurst* v. *Macpherson*, as also in the case of *White* v. *Hindley Local Board*, both of which were relied on by Mr. Justice Stephen in delivering the judgment of the court in Kent *v.* Worthing Local Board, the accident had happened by reason of a defect in the thing complained of; and it is not disputed that if the gratings over the manholes in the present cases had been out of order, whereby the accident had occurred, the defendants would be liable. It appears that upon reading the judgements in the case of *Moore* v. *Lambeth Water Co.* that this court expressly held that as the fire-plug in that case was in perfect order at the time of the accident, which was caused not by reason of any infirmity in the fire-plug, but by reason of the non-repair of the highway over which the defendants had no control, no action was maintainable against them, and so far overruled the decision in *Kent* v. *Worthing Local Board*, which had held that although the valve was in perfect order when the accident happened, it was the duty of the Local Board if necessary to cut it down or to otherwise alter it if it came to project up into the highway, and for that breach of duty an action was maintainable. The court however threw out the point which had not been suggested before, that perhaps *Kent* v. *Worthing Local Board* might be upheld, upon the ground that the defendants occupied the dual capacity of owners of the valve and owners of the highway; Lord Esher stating that if *Kent* v. *Worthing Local Board* could not be supported upon the ground of the defendants being masters of both situations, he respectfully differed from it, and that it was wrongly decided. Lord Justice Lindley, referring to *Gibson* v. *Mayor of Preston*, said, "It may be that the principle of that case does not apply to a road authority, where they have a control, not only over the road but over the thing which creates the nuisance . . . . if *Kent* v. *Worthing Local Board* is not to be distinguished from this case upon that ground, then in my opinion it is erroneous;" and Lord Justice Lopes was of opinion that by the judgment they were then giving they were overruling *Kent* v. *Worthing Local Board*. The point suggested by this court in *Moore* v. *The Lambeth Waterworks Co.* now comes up for decision. But it was first argued for the plaintiffs that there was no such thing as a highway authority as distinct from a sewer authority: that a Local Authority is represented by the Mayor, Aldermen and Burgesses acting as an urban sanitary authority; that under section 149 of the Public Health Act, 1875, the highways are vested in them; and that under that section they can do what they like with their highways, irrespective of being surveyors of highways; and that these actions were therefore maintainable against them wholly apart from their being surveyors of highways. These arguments are those urged in the Queen's Bench in the case of *Gibson* v. *The Mayor of Preston*, yet the judgment was that as the Local Authority were *de facto* surveyors of highways, they were not liable to an action for damages occasioned by reason of non-repair of the highway, and that the Public Health Act of 1848 had not imposed upon a Local Authority any further liability as to this than attached to a surveyor of highways. That this judgment was correct is now settled by *Cowley* v. *Newmarket Local Board* in the House of Lords last year. It was sought in that case to overrule Gibson v. Mayor of Preston but without success. The same arguments were again produced and with like results. In my opinion, the invalidity of these arguments has been judicially decided by the Queen's Bench and the House of Lords. The plaintiff next sought to rely upon a passage in Lord Blackburn's judgment in Geddis v. Proprietors of the Bann Reservoir, where the learned judge said, "It is now thoroughly well established that no action will lie for doing that which the legislature has authorised, if it be done without negligence, although it does occasional damage to anyone; but an action does lie for doing that which the legislature has authorised, if it be done negligently. And I think that if by a reasonable exercise of the powers either given by statute to the promoters or which they have at common law, the damage could be prevented, it is within this rule 'negligence' not to make such reasonable exercise of the powers," I do not doubt this as a general proposition, but I must point out that Lord Blackburn was not dealing with the case of the liability or non-liability of surveyors of highways, which is in itself peculiar. If this general proposition be applied to the case of a surveyor of highways, it appears to me that his immunity from being sued for non-feasance would be gone. By a reasonable exercise of his powers he could always repair a highway, and according to that proposition he would be guilty of negligence and liable to be sued if he did not do so; but this is not the law. Moreover, this same argument was addressed to the House of Lords in *Cowley* v. *Newmarket Local Board*, and though the case of *Geddis* v. *Proprietors of the Bann Reservoir* was not cited, others to the like effect were dealt with by Lord Herschell in his judgment and held not to apply. Lord Herschell in quoting Lord Cairns, states that, "much must depend on the purview of the legislature in the particular statute, and the language which they have there employed." When examined it will be seen that in the present cases, the defendants have been guilty of no neglect of duty as regards the gratings: what they have been guilty of is a non-feasance as regards their highways, to which as the County Court Judge has found the accidents which occurred to the plaintiffs were solely attributable. For this non-feasance, as above pointed out, no action can be maintained. If the gratings had been out of order in themselves, it would have been the duty of the defendants irrespective of being surveyors of highways to have put them in order, and if by neglect of such duty a passer-by had been injured he could have sued the defendants for damages; but as long as the gratings lawfully and properly put down, remained in perfect order, Moore *v.* Lambeth Waterworks Co. in this court has decided there is no breach of duty in the defendants in leaving the gratings alone. If the defendants were to be held liable in these actions they would have to be held liable for the non-repair of their highways, and this cannot be done. In my judgment for the reasons above, the defendants are not liable and upon the facts of these cases it matters not whether the defendants were "masters of both situations" or not, and that the case of *Kent* v. *Worthing Local Board* was in reality overruled by *Moore* v. *The Lambeth Waterworks Co.*, as stated by Lord Justice Lopes in his judgment in the latter case. The case of *Moore* v. *Lambeth Waterworks* standing, the case of *Kent* v. *Worthing Local Board* cannot. These appeals must therefore be allowed.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Before JUSTICE ROMER.

THE LOCAL BOARD FOR THE DISTRICT OF MINEHEAD *v.* LUTTRELL.

79 *L. T.* Rep. n. s. 446.

A landowner if he constructs sewers for the purpose of drainage and receives a voluntary sewer rate, is held to have made sewers for "his own *profit" within the meaning of sec.* 13, *sub-sect.* (1) *Public Health Act,* 1875, *such sewers therefore do not vest in the Local Authority.*

In 1878 G. F. Luttrell Esq. the Lord of the Manor, and owner of a great portion of the town of Minehead provided no small portion of the sewers, expending about £5,000. In respect of this outlay he annually received from the occupiers, &c., a voluntary sewer rate varying in amount from year to year. A part of the town called "The Park" belonged to Sir Thomas Dyke Acland, and there was the Great Western Railway Station which belonged to the Company. The drainage of the houses in the Park was made by the owner, but the drains were connected with the sewers made by the defendant on the understanding that an annual sewerage rate should be payable to him. A sewerage rate was in fact imposed on all the owners and occupiers of houses whose drains were connected with the main sewers of the defendant and was paid by all, except by the tenants of Sir Thomas Dyke Acland. As new houses were built, their drains were connected with the main sewers on the understanding that this sewerage rate should be paid.

The plaintiffs' brought their action claiming a declaration that the sewers, &c., were vested in them and asked for an injunction restraining the defendant from trespassing or otherwise interfering with their works.

MR. JUSTICE ROMER: If a landlord merely for the benefit of his tenants puts down a system of drainage, he cannot from these facts alone say that he made his drainage system for "his own profit," because the profit referred to by the Act of Parliament is not that interest, advantage, or gain, which may come to a landowner who improves his property by draining, by reason of his houses which are thus drained improving in value. The case for example of Acton Local Board *v.* Batten (52 L. T. Rep., 17) was a case clearly where the person who had made the sewers had not made them in any way for his own profit within the meaning of the section of the Act.

Bonella *v.* Twickenham Local Board (58 L. T. Rep., n. s. 299) was again a case where certain owners of land laid it out for building and made a street, and as part of their building operations they made a sewer to drain the houses in the street. It was held that it was not a case where the owners could be said to have put in these sewers simply for the purpose of profit within the section. So again Ferrand *v.* the Hallas Land Building Co. (69 L. T. Rep., n. s. 8) was a case where a landowner put in sewers for the sole purpose of draining the houses erected by him on his own land. None of those cases at all touch the case before me or the facts upon which I have to decide this case. This is a case where defendant has laid out money for the purpose of making sewers, intending to be compensated and paid directly for his expenditure upon the sewers, by receiving payment from every person, whether his tenants or not, who avail themselves of the benefit of his sewers by the person using them.

The action fails and must be dismissed with costs.

Before JUSTICES MATHEW and COLLINS.

HIETT (APPELLANT) v. WARD (RESPONDENT).

(*Times*, Feb. 16, 1894.)

Obtaining Samples of Milk.

Hiett was a farmer near Swindon, and on the 21st September last one Douglas was about to deliver to a shopkeeper at Swindon, where milk was sold by retail, a churn of milk which came from Hiett. The respondent Ward, an inspector appointed by the Wilts County Council, stopped Douglas and demanded from him a sample of the milk. Douglas objected, and Ward then explained that he was liable to a penalty if he refused, and then the inspector bought and Douglas sold a pint of milk, for which the inspector paid. The inspector then, in the presence of Douglas, both having gone into the shop of the retailer, proceeded to divide the sample into three portions (under the enactment in the first Act), giving one to Douglas and one to the county analyst. Douglas took the sample he had to Hiett, who, however, refused to receive it, saying that he had sold nothing to the inspector. The county analyst reported on the sealed sample he received, and gave a certificate which supported the charge in the summons and information—viz., that Hiett had by Douglas sold the milk, which contained 10 per cent. of added water, "to the prejudice of the purchaser," and the magistrates on the evidence found the charge proved, and no question arose on the merits. But objections were taken on the part of Hiett that there was no sale by him of the milk in question, as Douglas, the carrier, was not his agent to sell it, and that the summons was bad for stating that he was. The cases of "Harris v. Williams," 6 *The Times* Law Reports, and "Rouch v. Hall," Law Reports, 6 Q. B. D., were cited on the question whether the conditions of the enactment in the earlier Act applied. The magistrates found that Ward had no power to enforce a sale; that Douglas sold under compulsion; that the sale, if made, was without authority; and that Ward took the sample, under the compulsory power, citing "Rouch v. Hall," 6 L. R., Q. B. 17. They convicted Hiett, but they left to the Court the questions whether he was rightly convicted; whether Ward was obliged to comply with the conditions in the 14th section of the first Act; and whether the statement in the summons of a sale by Douglas vitiated it.

Mr. NEVILLE, for the appellant, urged that as the information and summons alleged a sale by Douglas and an adulteration "to the prejudice of the purchaser," it was essential to prove a purchase, and that as Douglas had no authority to sell the case failed.

Mr. GORE BROWN, for the respondent, pointed out that, even assuming any variance, it is clear that under Jervis's Act it would not affect the conviction, being a mere variance, and not "of the essence of the charge."

Mr. JUSTICE MATHEW, in giving judgment, said it was at the utmost a mere variance in the form of the summons. The magistrates clearly had jurisdiction to deal with the case, and the conviction must be upheld.

Mr. JUSTICE COLLINS said he was of the same opinion.

Conviction accordingly affirmed, and appeal dismissed.

QUEEN'S BENCH DIVISION.

Before Lords Justices Charles and Collins.

(*Times*, April 16th, 1894).

Under the Public Health (London) Act, 1891, *sections* 4 *&* 12, *a notice to abate a nuisance may be served on the "owner" and left on the premises, in like manner a "summons" against the owner may be left on the premises.*

Section 4 of the Public Health (London) Act, says, "The Sanitary Authority shall, if satisfied of the existence of a nuisance, serve a notice on the person by whose act, default or sufferance, the nuisance arises or continues."

Section 128 of the same act is to the effect that any notice or order or other document may be served by delivering a copy, at the last known place of abode of the person to whom it is addressed; or where addressed to the owner or occupier of premises, then to some person on the premises.

The sanitary inspector of Poplar had taken out a summons for non-compliance with a notice; the summons was directed to "the owner" and had been left on the premises. The magistrate (Mr. Mead) dismissed the summons on the ground of improper service and the prosecutor had obtained a rule *nisi* for a *mandamus*. After hearing Mr. Sutton on behalf of the magistrate, Mr. Muir, on the part of the prosecution, said, that practically in many cases the only possible procedure was against "the owner," whose name it might often be difficult to ascertain and in the mean time the nuisance would remain unremedied. Therefore the notice and the summons might be addressed to "the owner" and left for him on the premises. The whole object of the new Public Health Act, was to provide for the summary remedy of nuisances by notices to an unknown person as "owner" and on that a summons might issue, the object being only to make an order for abatement of the nuisance which involves no personal liability, unless under another section for "wilful default." No doubt an unknown person cannot be subject to fine or penalty. But if the owner appears upon the summons issued against him as "owner" then a fine may be inflicted upon him, and even if he does not appear the order to abate the nuisance may be made; that is the very object of the Act.

The Court delivered the following judgment:

Lord Justice Charles said his first impression was, that the magistrate was right, but he was now satisfied that a summons was a proceeding, which might be made out against "the owner" without name. But then the more difficult question arose as to whether the summons had been properly served, and he came to the conclusion that it had been. The summons had been served under section 128 by leaving it on the premises, and the question was whether section 128 applied to the service of such a summons; and he thought that it did, and that under section 8 it was not necessary to proceed under Jervis's Act, and that this proceeding by summons might be resorted to although the name of the owner was not known. Any notice or other document directed to the owner may be served by being left with anyone on the premises. It was argued that the terms did not include a summons, but he thought that it did, and that, on the true construction of sub-section 1 of section 128, a summons may be so served. At first sight it might seem strange that an unknown person might be fined, but that was not so, for, though the order to abate the nuisance might be made on the unknown owner, he could not be fined unless he appeared. Under these circumstances, therefore, he came to the conclusion that the summons was rightly served, and that the magistrate ought to have proceeded upon it.

Lord Justice Collins gave judgment to the same effect.

Rule for an order in the nature of a *mandamus* to the magistrate made absolute.

QUEEN'S BENCH DIVISION.

Before **Lord Chief Justice Coleridge**, and **Lords Justices Wright** and **Kennedy**.

THE UNITED ALKALI CO. *v.* SIMPSON.

(*Times*, April 24th, 1894.)

Under 54 *George III.*, *c.* 159, *section* 11, *alkali waste and chemical deposits are included in the terms "earth, rubbish, or filth." It is not necessary under the statute to show that the deposit of the sediment tends to obstruct navigation, it is an offence to deposit the sediment in places where it might be washed into the sea or the river.*

The 11th section of 54 George III., c. 159, an Act to protect navigable waters enacts, "that any person working any quarry, mine, or pit, near to the sea, or to any such harbour, haven, or navigable river as aforesaid, or any other person or persons whatsoever, shall cast, throw, empty, or unload, or cause or procure to be cast, thrown, emptied, or unladen, either from or out of any such ship or vessel, lighter, barge, or other craft, or from the shore, any ballast, stone, slate, gravel, *earth*, *rubbish*, wreck, or *filth*, so as to tend to the injury or obstruction of the navigation thereof, or in any place or situation on shore where the same shall be liable to be washed into the sea, or into any such ports, roadsteads, harbours, havens, or navigable rivers, either by ordinary or high tides, or by storms or land floods, all and every such person or persons shall for every such offence forfeit and pay a sum not exceeding ten pounds, over and besides all expenses which may be incurred in removing to a proper place the said matters which may have been deposited contrary to the provisions of this Act."

This was a case stated by the Justices of Lancashire on an information at the Widnes Petty Sessions, in the division of Prescot, Lancashire, preferred by Simpson against the Company under the 11th section of an Act to protect navigable waters (54 Geo. III., c. 159), charging that the Company in May, 1893, at West Bank, Widnes, caused to be cast alkali waste, in a place on shore near their chemical manufacturing works, where the same was liable to be washed into the River Mersey by floods or tides, contrary to the statute. Upon this information the Company was convicted and fined, and so on two other similar informations. But the magistrates stated a case for the opinion of this Court, which now came on to be heard and argued. The informations were laid by Simpson, on behalf of the acting conservator of the Commissioners for the Conservancy of the River Mersey. The Company at their works carry on the business of alkali manufacturers, and in the course of such manufacture, a refuse or waste is produced known as alkali waste. This waste product, to the extent of many thousand tons in the year, was formerly placed in heaps or mounds on the nearest vacant space; but the Company, partly to prevent the necessity for depositing the alkali waste and partly to utilize it by extracting the sulphur from it, have lately put in use at their works, in the course of their manufacture there, a certain chemical process known to the trade as the "Chance process;" and they have also there treated by the same process quantities of alkali waste procured from other works of the Company, and brought to the works for that purpose. The "Chance process" is a method of treating alkali waste (after it has been mixed with water) with carbonic acid gas, whereby sulphuretted hydrogen gas is evolved in close tanks, and utilized for the production of sulphur, and the residue is left in the tanks in the form of a liquid containing in suspension solid matters in a finely divided state, which, when deposited, form a mud, which is known in the trade as "Chance mud." The solid matters in this residue consist of about 87 per cent. of carbonate of lime in a very finely divided condition, and about 13 per cent. of other substances in a similar condition. These solid matters were kept in suspension in the water while in the tanks by means of agitators revolving slowly inside the tanks. On May 16th, 1893, and for some time past, the Company discharged this residue from the tanks through 4 in. pipes, which carried it into sewers belonging to the works, where it would mix with other drainage of the works, and by means of these sewers it was discharged into a natural brook, known as the Marsh Brook (not the property of the Company), at a point about 500 yards above where the brook falls into the River Mersey. The solid matter thus discharged in each week would have weighed about 567 tons. The brook sewer serves as a drain to a number of other works and manufactories, and to carry away surface water from a considerable district. The brook is tidal up to and beyond the point where the sewers from the works discharge into the brook. It was proved, and found as a fact, that part of the solid matter thus discharged from the works into the brook became deposited in the brook from the point of the outfall of the sewers into the brook downwards; and that the remainder of the solid matter was carried down the brook and into the River Mersey by the tide or by other water flowing down the brook; and further, that part of the solid matter carried in suspension, was deposited on the shore of the Mersey near the outfall of the brook between high and low water marks. The question was whether the conviction of the Company was warranted under 54 George III., c. 159, s. 11. On the part of the Company it was contended that it was not, on the grounds—(1) that the Company are not "persons" within the enactment; (2) that the stuff discharged was not "earth, rubbish, or filth" within the enactment: (3) that the evidence did not disclose any case of casting or throwing on shore where it was liable to be washed into the sea or any navigable river, as it was proved that the point at which the stuff was discharged into the brook was about 500 yards above where the brook falls into the Mersey; (4) that the acts complained of, do not constitute an offence under the enactment unless it be shown that such acts were committed "so as to tend to the obstruction of the navigation of the river," and that the conservators had not alleged nor proved any obstruction to the navigation. The magistrates, however, being of opinion that the objections raised were not good in law, convicted the Company, who upon the case thus stated now appealed.

Mr. JOSEPH WALTON, Q.C. (with Mr. Deacon), appeared for the Company and argued on their behalf, citing on the first point "The Queen *v.* Clewer" (4 Best and Smith), as showing that the Company were not included within the terms used. The words used did not include chemical deposits. Neither "rubbish" nor "filth" would be applicable to such deposits. Fine deposits such as this stuff in suspension in water cannot be called "earth" or "rubbish." [LORD COLERIDGE.—Is it not "filth"?] No, for it is not said to be offensive. The Legislature did not intend to interfere with chemical or manufacturing processes, and thus to interfere with industrial enterprise. If this conviction be supported, it will affect all works or factories near any brook which discharges into a navigable river, though there is really no danger of obstruction to the navigation. The object of the Act is to protect navigation, and the plain natural meaning of the words is to do so.

Sir H. JAMES (with Mr. Carver) appeared for the Conservators in support of the conviction. Surely, he said, this Company was within the Act? And surely this sediment was "rubbish" or "filth"? [The COURT intimated that they agreed on both points.] Then the only remaining point is the question whether it is necessary to show that the deposit of the sediment tended to obstruct the navigation. Can it be doubted that in fact the throwing of about 600 tons a week into the river must have that effect? But that is not a necessary part of the offence, which is throwing it in.

The LORD CHIEF JUSTICE delivered judgment to the effect that the conviction was right, and that it was not necessary to show a tendency to obstruct the navigation. It was an offence to deposit the sediment in such places that it might be washed into the sea or the river.

The other Judges concurred.

Appeal dismissed with costs.

QUEEN'S BENCH DIVISION.

Before JUSTICES WILLS and WRIGHT.

TRAVIS *v.* UTTLEY.

(70 *L. T.* Rep. 242)

A drain passing under and receiving the sewage from three houses is a sewer within the meaning of Sec. 4, *P. H.* 1875.

This was a magistrates case stated for the opinion of the Court.

Three houses Nos. 105, 107, and 109, Fern Street, Boothtown, Halifax, were built in 1868 and at that time the block plan was deposited with the local authority; the houses were drained by a common drain running under the centres of the basements. In 1893 a nuisance existed in the cellars of Nos. 105, and 107, Fern Street, caused by the drain under No. 105 being defective. No. 105 was the lowest house, No. 109 being the highest. The Inspector of nuisances (Travis) served a notice on the owner of the houses to abate the nuisance and subsequently in non-compliance, summoned him. The Justices were of opinion that according to the wording of the Act and to the leading cases, the information should be dismissed but they granted a case for the opinion of the Court.

Mr. FORBES, Q.C., and Mr. MACMORRAN, for the appellant: It is possible that, if the defining section were construed very strictly the result might be that this drain would be a sewer within the Act as far as regards the part passing under the two lower houses. But the part draining the first house would still be only a drain; and it is not necessary to construe the section so as to produce this anomalous result and other parts of the Act, show that, that is not the true meaning. Sec. 15 requires the local authority to keep sewers in repair, and Sec. 18 empowers them to make any necessary alterations in the sewers. If, therefore this is a sewer the local authority may enter the house and pull up the floors to get at the drains at any time. The Legislature can never have intended to give such powers by mere implication, Secs. 19, 21, 25, 26, and 150, dealing with the connection of private drains with sewers and other matters, are all inconsistent with the idea that a drain passing through private ground or under a house can be a sewer.

Meader v. *West Cowes Local Board* (67 *L. T.* Rep., n. s. 454). *Acton Local Board* v. *Batten* (52 *L. T.* Rep., n. s. 17). (*Ferrand* v. *Hallas Land and Building Co.* (69 *L. T.* Rep., n. s. 8).

Mr. TINDAL ATKINSON, Q.C., and Mr. R. CUNNINGHAM GLEN, for the respondent having been heard, the following judgments were delivered.

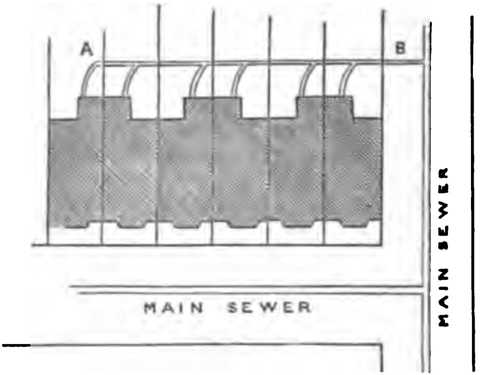
Mr. JUSTICE WILLS: The respondent was the owner of a property as long ago as 1868, and at that time he submitted plans to the Local Board in which he bracketed together every three of the houses he proposed building for purposes of drainage, so that in each of these cases the drain would run under the three houses, receiving first the drainage of one, then that of the two others, then carrying out to the main system of the town. These plans were approved. At that time the Public Health Act of 1848 was in force. The Act of 1875 has since come into operation. Lately the drain of one of these sets of three houses has got out of order and has caused a nuisance, the Local Board has ordered it to be put right, but has been met with the answer that it is a sewer and that it is therefore not the respondent's business to repair it. There is no real difference that I can discern, no difference that touches this case, between the legislation of 1848 and that of 1875. So, if there is any difficulty here, it is due to the predecessors of the Local Board who approved the plans in accordance with which these houses were built. All we have to decide is, the question whether such a drain is a sewer within the meaning of the Act. Now the definition in the Public Health Act of 1875, is perfectly clear and is the same as that in an earlier Act. It is, that any drain which drains more than one building is a sewer. Words cannot be plainer. This drain is used for the drainage of more than one building. It is therefore a sewer. It is not, I think, possible to draw any distinction between the part of this drain which drains the first of these houses and that which drains the other two. For in that case the part of a drain serving any house at the top of a *cul-de-sac* would not be a sewer, which seems contrary to common sense. I can find here no inconsistency or inconvenience which would justify us in disregarding the plain meaning of the section. I have always understood that such inconsistency must be something in the section itself or in the rest of the Act. There is no such inconsistency here. The inconvenience is only of importance as showing the true intention of the legislature. So I cannot see any reason for not adopting the plain meaning of the section, or why we should not say that it is a sewer, and that the Local Authority must keep it in order. I am thoroughly aware that this may be very inconvenient for the Local Authority in this Borough, but they have, as I have said, to thank their predecessors for this. The words of the section are plain, and must be followed.

MR. JUSTICE WRIGHT: I am of the same opinion. There is an apparent absurdity in holding that this drain, apparently a private drain, is a sewer. It seems to be an absurdity in two directions: first, that it interferes with private property, by giving the Local Authority the right to come into a private house for the purpose of repairing a drain: in the second place, because it throws the burden of doing repairs on private property on the Local Authority. But the words of the section are plain and the result perhaps not really unreasonable. It may have been foreseen that complications would be likely to arise from the use of the same drain by several houses and the intention may have been to avoid these. At any rate I have tried to see a way out of holding this to be a sewer and I cannot. I thought at one time during the argument that the section would not apply to a drain which was part of a house, but a drain might run under many houses belonging to different people. Or again, I thought it might not be a sewer because it ran through private grounds: but many sewers may do this which yet ought to be clearly under public control. I think it is best to adhere to the plain words of the section. Appeal dismissed.

GENERAL NOTES.

QUERIES.

Could you favour me with any information on the case sketched below? A B under the Public Health Act, 1875, is a "*sewer*," but I believe, under sec. 19 of Public Health (Amendment) Act, 1890, it becomes a "*drain*," and the Local Authority can recover any money expended on it from the various owners of the houses draining into it, the same being proportionally divided amongst them by the Surveyor. I should be glad to know if this is so. *And do you know of any cases where Local Authorities have recovered money expended on a drain such as A B?* W. H. M.



Whether A B becomes a drain under sec. 19 of the Public Health (Amendment) Act, 1890, depends in the first place whether the Local Board have adopted that Act or not; and in the second place, as to whether the houses are owned by different owners. Presuming that the Board have adopted the Amendment Act, and that under that Act A B has become a "drain," they can recover money expended on it, provided they have strictly conformed to sec. 41 Public Health Act, 1875; but if they have omitted to give the necessary notices, it is most doubtful. I know of no case in point. A. W. B.

Pollution of a River—Before Judge Lushington, at Aldershot recently, the Hartley Wintney Sanitary Authority sued the Aldershot Local Board of Health for penalties for non-conformance with an order calling upon them to abstain from polluting the river Blackwater. The case has been before Judge Lushington on several occasions, although an order to abstain was given so far back as 1883. Since that year his Honour has permitted several adjournments to allow the defendant board to avail themselves of the best means to prevent the pollution of the river. The Aldershot Local Board have adopted several processes, but the plaintiff authority contend that they have not used the best means according to the Rivers Pollution Act, and they now asked his Honour to impose penalties for three specific dates—viz., September 16 and December 26 and 27, 1893, His Honour decided that on the dates named the Aldershot Local Board were not availing themselves of the best and most practical means of obtaining a satisfactory effluent, and imposed a fine of £20 for each of the specified dates, giving the plaintiffs costs.—*Times, March 23rd*, 1894.

A Hamburgh Housing of the Working Classes Act.—A recent law adopted by the authorities of Hamburgh is to the following effect:—Every dwelling place intended for permanent habitation must have its own separate door, its separate cooking place, and W. C. accommodation. Several families cannot use the same room, save the room is divided up by partitions. Lodgers are to be separated as to sex. Every inhabited room is to be lit by a window, the surface of which must be a tenth of the floor space at least; in sleeping rooms, every child under 10 years must have at least 0·1 square foot of window space, and older persons at least 2·0 square feet; the cubic space for the same ages is to be at least 176 cubic feet for the younger, and 353 cubic feet for the older persons, and the floor space from 21½ to 43 square feet per person. Children under 1 year belonging to the family are not to be taken into account in the carrying out of the ordinance.

Defects in Iron Vessels.—Mr. S. Dimond, Chief Inspector of Nuisances for the Port of Bristol, again calls attention, in the Report for 1893, to the universal want of wood lining to all crew spaces built of iron, without which these places are a constant source of nuisance and danger to the health of the inmates, in damp, rough, and frosty weather, when the sides and tops of such places reek with water or are covered with a thick coat of ice, and everything in the place becomes saturated with moisture, especially when, through stress of weather, a fire cannot be lighted. This state of things is seldom seen in the cabins or officers' berths, as they are mostly lined, and he thinks it not too much to ask for the crew-spaces to be treated in the same way. It is difficult to deal with this matter as a nuisance in harbour, as the ship is not exposed to the same conditions, and on a fire being lighted the place is partly dried up and the evidence of nuisance removed, and the only practical way of dealing with the matter is for the Board of Trade to insist on all living spaces being fitted with wood lining (removable if necessary) when the ship is built, or when under survey. In justice to owners it must be allowed that many have fitted up a narrow strip of wood over the sleeping bunks, which is all they are required to do by the Board of Trade regulations, but some have lined the berths entirely, in such ships the increase of comfort is great.

Sanitary Inspectors' Visit to Prestwich.—On Saturday, 26th May, 1894, the members of the Manchester Centre of the Sanitary Inspectors' Association paid a visit to Prestwich, and were received in the Board Room (kindly lent for the occasion) by several Members of the Board, the Medical Officer of Health, the Surveyor, and the Inspector. After a short descriptive account of the Sewage Works had been given by Mr. Peel, C.E., Surveyor, light refreshments were partaken of, and the party proceeded to the Asylum Farm and were shown over the creamery, shippons, stables, and piggery, which were a model of cleanliness, and reflected great credit on the Farm Bailiff, Mr. Davies, who was in attendance and explained matters. Thence to the Sewage Works, where the lime process was explained, which, owing "in no small measure to the properties of the sewage in the district," gives great satisfaction at little cost. The party then visited the Mortuary and the old Church, being afterwards entertained most loyally at the Red Lion Hotel by Mr. Mellor, Sanitary Inspector of Prestwich. Inspectors from the following Sanitary Authorities were present:—Aston-under-Lyne, Barton-upon-Irwell, Dukinfield, Gorton, Glossop, Hyde, Heywood, Manchester, Middleton, Prestwich, Ramsbottom, Salford, Stalybridge, Swinton and Pendlebury, and Withington.

The International Sanitary Conference.—The Sanitary Conference of the Governments of Europe and the United States has concluded a long inquiry in Paris, as to the best means of preventing the spread of cholera in the East. The result has been the signing of a convention by all the Powers with the exception of the United States, Holland, and Turkey. The United States have no pilgrims or pilgrim ships to or from the East. It is hoped that the Sultan will not long withold his assent to measures aimed at ameliorating the lot of Mahomedan pilgrims. Great Britain felt it necessary at the last moment, for the sake of Indian pilgrims, to make certain reservations—firstly, that two mètres of space on board ships for pilgrims are excessive; secondly, that the extension of the provisions of the agreement to the Persian Gulf is of doubtful practicability; and, thirdly, that it is impossible to insist upon pilgrims showing they have sufficient means to reach and return from the holy places before allowing them to leave their native shores. The convention aims at extending to the East the convention for preventing the spread of cholera, agreed upon for Europe at the Cholera Conference, held in Venice and Dresden in 1892 and 1893, the principle of which was to give up treating ships according to the health of the ports from which they sailed or touched at on their voyages, and to do away with quarantine. The principal point in the convention is that only the sick will be detained on landing. The climate of the Red Sea and Arabia is most trying, even for the natives of India and the Dutch East Indies. Therefore the shorter the time a pilgrim is in Arabia, the better. Under the convention, if no case of illness is shown on board his ship, the pilgrim will be at once landed and his clothes thoroughly washed, and he will be allowed immediately to proceed to Mecca. Under the old rules, a ship was so repeatedly quarantined, that the pilgrims were prevented from reaching Mecca in time for the religious ceremony. The sanitary condition of the quarantine stations of the Red Sea left much to be desired, therefore the convention lays down in full detail what is necessary to be done in cleansing work. Emphasis is laid on the necessity of having an undoubtedly uncontaminated fresh-water supply in abundance. This is accomplished by the deepening of the wells which now supply water to the Red Sea littoral and the pilgrim routes to the Hedjaz. Especially at the quarantine stations where the water may be found to be good. If this is not enough, distillation will be adopted, and contamination of the wells is to be carefully guarded against. This convention when carried out will not affect the incursion of cholera into Europe, but it will ameliorate the lot of the Indian pilgrim. In 1883, cholera existed in Egypt and came from that country in 1884-5 to Europe, but the great epidemics of cholera have always come to European countries by a route through Afghanistan and Russia.

THE LABOUR COMMISSION'S report deals with some sanitary points. Under Section 8 of the Factory and Workshop Act, 1891, the Secretary of State has power to establish special rules for the conduct of manufacturing processes which he may certify to be, in his opinion, dangerous or injurious to health. It seems to be the fact that physical exhaustion increases the risk of accident or the susceptibility to disease in some occupations, and we think the powers of the Secretary of State under this section should be expressly extended so as to include the regulation of hours in certified industries. When the administrative orders made in these cases deal with the employment of women and young persons they might be final, but when they directly relate to the hours of adult workmen they should, we think, be laid for a certain period before both Houses of Parliament before becoming law. The evidence we have received brings us to the conclusion that some modification should be made in these provisions of Section 53 of the Factory and

Workshop Act, 1878, which permit women and young persons to work overtime for forty-eight days in the year in various specified occupations, including dressmaking. The number of days in which such overtime is allowed might, in our opinion, be reduced with advantage, and we think that in the case of young persons no overtime at all should be permitted under this section. We are of opinion that, so far as relates to the hours of young persons and to all sanitary matters, the provisions of the Factory and Workshop Act should be made to extend to laundries. Many sanitary evils would be obviated if it were possible to carry out thoroughly the provisions of the Factory and Workshop Acts and of the Public Health Acts. Some strong measures should be taken with a view either to the improvement or gradual extinction of the lowest class of workplaces in which the "sweated" industries are carried on. Legislation is desirable so that all occupiers of workshops (exclusive of domestic workshops), and perhaps also of factories, shall be required under penalties to obtain a certificate from a competent public authority to the effect that the premises used by them are in all respects in a sufficiently sanitary condition, and contain sufficient cubic space for the number of persons employed in them, and that all contractors and shopkeepers in these industries who employ out-workers should be responsible, if the work done in workshops, that it is only done in those which had a proper certificate. Regulations of this kind appear to the Commissioners to be urgently required in the case of the manufacture of articles of clothing (including boots and shoes) and cheap furniture. The proposed regulations should also extend to bakehouses and laundries. As to the agricultural labourers, the chief evil to which it appears possible that legislative or administrative remedies may be applied is the defective structure and sanitary condition of the houses of agricultural labourers in many districts in all parts of the country.—*British Medical Journal.*

THE NEW SEWAGE UTILISATION AND PURIFICATION WORKS of the Corporation of Glasgow have cost £100,000, and will treat one-fifth of the sewage of the City, or about 10,000,000 gallons per day. The water which passes out of them into the Clyde after the solids and impurities have been separated in the works is quite clean and sanitarily pure. If this can be done for one-fifth of the sewage, why not for all? and if Glasgow can do this, why not all the towns on the Clyde, which, above Dumbarton at any rate, is a stream of pollution and unutterable stenches? Lord Provost Bell is believed to have set his mind on the purification of the Clyde as the great work of his life. If so, he is to be congratulated on a beginning having been made—and it is the first step that costs.—*Fairplay, May 11th*, 1894.

LIVERPOOL'S WATER SUPPLY.—The statistics from the engineer's periodical report for the week ending 7th April, 1894, showed the distribution of water in Liverpool and the out-townships, within the limits of compulsory supply, for the week ending 7th April, 1894, and for the corresponding week last year, to be:—1893—From Rivington and Vyrnwy, 110,583,000 gallons; from wells, 25,907,000 gallons; total, 136,490,000 gallons. 1894—From Rivington and Vyrnwy, 95,835,000 gallons; from wells, 44,804,000; total, 140,639,000 gallons; increase in 1894, 4,149,000 gallons. The above figures do not include water supplied to Chorley and in bulk to other places outside of the compulsory limits, amounting, for the week, to about—For Chorley, 2,451,000 gallons; for other places, 5,417,000 gallons; total, 7,868,000 gallons.—*Liverpool Courier, April 11th*, 1894.

IT IS REPORTED FROM GERMANY that some interesting experiments have been made in the treatment of diphtheria with "diphtheria serum," a preparation made in the Berlin Hygienic Institute. The experiments were made in six Berlin hospitals, the total number of children treated being 220. Of these, 168 were cured, being 66·4 per cent. Tracheotomy was performed on 77, of whom 37 were cured, this being 55·1 per cent. The results on the whole are therefore very favourable. The success of the treatment depends a great deal on when it is begun. Of those treated on the first day of the disease all were cured; of those on the second day, 97 per cent.; on the third day, 86 per cent.; on the fourth day, 77 per cent; and on the fifth day, 56·5 per cent. Of the 72 children who were brought in during the first two days of the illness only two died.

SANITATION IN THE MERCANTILE MARINE.—The British Medical Journal of the 14th April, advocates the publishing of an annual report upon the health of the merchant service. The report to contain a full and reliable account of the mortality of crews and passengers, and a record of injury and sickness at home and abroad, returns of the physical condition of seamen and the accommodation provided on board ship, provisions and water. These to be obtained from reports of Consuls, port medical officers, seamens' hospitals, the Board of Trade and other sources. Records of quarantine, foreign and domestic, and of official inquiries upon sanitary matters to be also included. The incapacity or neglect of ship masters appears to lead not infrequently to the non-recognition or concealment of disease and to the danger of importation of infection. The average mortality in the merchant service is nearly double that in the Royal Navy. Mr. W. G. Black, F.R.C.S., writing in the British Medical Journal of the 21st April, after alluding to the sickness and mortality on board mercantile ships, leading to their undermanning and presumably to danger in navigation, draws attention to the indequate provision for the housing of crews, both in cargo and passenger ships. The forepeak berth in cargo ships is like a guard-room, the light and air deficient, and the wooden bunks are unprovided with mattress or pillow; there are no pegs for drying wet clothes, no lockers to store dry clothes, no table for reading, writing, and other purposes, and often no lamps and no lavatory to wash in. This often is painful contrast to the luxurious fittings of a first-class passenger. The men on first-class ships are far superior to the class of the bygone days, and are entitled to better accommodation than that given to the victims of the press-gang of old times.

AT A RECENT MEETING of the "German Association of Public Health of Berlin," Mr. Bernstein, engineer, read a paper upon "A method of dealing with the milk supplies of large towns." Milk transport from long distances presents difficulties of a mechanical and chemical nature. The mechanical difficulties are the rising of the cream or fatty matter and also the churning into butter. The former takes place when the milk is still and the latter when it is in motion, two opposite conditions. Chemical changes, produced by bacteria, also takes place in the composition of the milk, the most frequent being that of "souring." All these difficulties, the reader stated, may be overcome by transporting the milk at a given higher temperature. This temperature he places at 70° C. (158° F.), having arrived at this conclusion, after many experiments, that 72° C. (161·6° F.) is the limit of temperature for the multiplication of bacteria. He stated that the taste, smell, and appearance of the milk remained unchanged at this temperature.

OVERCROWDED WORKROOMS.—Against Harris Weinberg, tailor, of 39, Pelham Street, Spitalfields, five summonses for over-employment, overcrowding, and neglecting to affix notices of the conditions of work in the factory were brought at Worship Street.—Mr. Lakeman said his assistant, on going to the place at half-past nine at night found eleven men and two boys at work in a room containing only 1,800 cubic feet of air space. There were nine stoves and two flaring gas jets in the same room, the place being like an oven. The air-space for each worker was less than 120 instead of 400 ft.—A solicitor for the defence said that defendant had no knowledge that his workroom had the number of persons stated in it. He employed only five hands, and some of those five had brought in others at their own expense to help the work in hand. He submitted that defendant was not the "occupier" under those circumstances.—Mr. Bushby summarily rejected the contention, and said he regarded the overcrowding of such places as deserving the severest penalty of the law. Weinberg was ordered to pay £10—the maximum fine—for that offence; and was fined £1 on each of four other summonses—a total of £14, with 14s. costs.

A BOROUGH BAKEHOUSE.—Thomas Young, baker, Scovell Road, was summoned at Southwark for permitting his bakehouse to be in an insanitary condition. Dr. Waldo said the bakehouse was entirely underground. To the oven there was only one damper instead of two, which had the effect of filling the place with vitiated air and steam. Stretched across the bakehouse there were five clothes lines, on which he found the wearing apparel of defendant and his family hung up to dry. On a small raised platform he found a mangle and a quantity of dirty clothes, by the side of which sacks of flour were stacked. The only daylight that could possibly reach the bakehouse was through a window, but the glass was broken and the window covered and blocked by a sack. This window was only 2 ft. above the street level, and the bakehouse became the receptacle for the dust that blew about the street. The water used for making the bread was supplied from a tap which was fixed over a small trap. In this trap he found a rolling-pin, which defendant said he placed there to prevent an influx of sewage, which repeatedly came up into the bakehouse. As the defendent had closed the premises, the vestry did not press the matter, and the case was dropped on payment of costs.

THE HEALTH OF RIGA—LEPROSY AND CHOLERA.—The last Consular Report on the district of Riga (For. Office, 1894, No. 1337) contains the following particulars:—

Most praiseworthy efforts continue to be taken to prevent the spread of leprosy. There are two asylums for these unfortunate persons in this province: one at Muli and the second at Nenal. A third is contemplated, and the necessary land has been allotted by the Livonian nobles. Last year there were 19 patients at Muli and 41 at Nenal. The number of beds in the latter asylum has been increased to 80; thus, there is now accommodation for 100 patients, the annual cost for each being about £10. Although there is not sufficient space for housing the large number of lepers in the Baltic provinces, the isolation of a portion is a great step in advance and of immense importance in battling against the spreading of this dire malady.

The cholera again made its appearance at Riga on October 5/17 last, and was officially declared on October 12/24, from which date daily bulletins were issued.

The last choleraic attack at Riga was on November 12/24. In all there were 53 cases, of which 21 proved fatal; the numbers last year being 151 and 75 respectively.

The character of the disease was not of such a malignant type as last year: it made its appearance a month later and only lasted 39 days. The persons attacked were mostly from the same localities and of the same classes as those last year, viz: labourers at the port and on board ships, and men engaged on the river, who, regardless of the notice published by the sanitary authorities, prefer to drink unboiled river water.

Since the building of the training walls and groynes in the Düna the current has been cut off at certain points, and it is feared that these quasi-stagnant places behind the dams will always prove a hot-bed for the dissemination of diseases.

The authorities renewed their energetic measures, and the experience gained last year enabled them to cope successfully with the epidemic. Several artesian wells have been sunk and were placed at the disposal of the inhabitants.

Regarding cholera, the following statistics have been published by the medical department.

The epidemic in 1893 was far from being so severe in Russia as in the year preceding, both as regards the number of persons attacked and rate of mortality.

In 1892, from the month of May up to September, there were 433,643 choleraic cases, whilst in 1893, from January to September, there were only 62,107 attacks. The number of fatal cases during the periods above mentioned in 1892 was 215,157, and in 1893 only 24.284 deaths.

Last year, up to September, the province of Podolia furnished the largest number of cases—15,679, of which 5,252 were fatal. Orel came next with 4,922 cases and 1,802 deaths; then Kursk, 3,229 attacks and 1,240 deaths; and the Don Cossack territory, 2,625 attacks and 1,262 fatal cases. The rate of mortality in 1892 was 49·6 per cent., which lowered to 39·1 in 1893.

The department considers this fact most satisfactory, as, according to the ordinary course of cholera epidemics, they generally become more widespread in the second year after their appearance.

Influenza still reigns, though of a mild type, otherwise the public health in these provinces has been good during the past year.

MEETINGS OF THE INSTITUTE APRIL TO JUNE, 1894.

LECTURES ON DOMESTIC HYGIENE.

A Special Meeting was held at the Parkes Museum on May 10th when Her Royal Highness the **DUCHESS OF ALBANY** presented the certificates awarded to 55 ladies who had written essays on the lectures on Domestic Hygiene given at the Institute by Dr. A. T. Schofield, Lent, 1893 and Lent, 1894.

Sir **DOUGLAS GALTON** presided, and in opening the proceedings said that the late Duke of Albany, who had taken much interest in the Institute, had made a great point of the catholicity of its aims. Before everything it was educational, and it was especially necessary that education in the laws of health should be begun early. It was, therefore, of the highest importance to enlist the assistance of women, whose duty it was to train children from their earliest days, and to safeguard the homes of the young in accordance with the soundest hygienic teaching. It was gratifying to him to state that several ladies had qualified to become Sanitary Inspectors. But the aim of the Institute was not restricted to the training of professional sanitarians; they wished to have their lectures attended by everyone who was to be the mistress of a household, and the Duchess of Albany had set a brilliant example by attending three courses of these lectures. Home matters had been dealt with by Dr. Schofield in an attractive manner, and the lectures had been very successful, more than 30 out of 140 ladies who attended having distinguished themselves sufficiently to receive certificates of merit at the hands of Her Royal Highness.

Sir **THOMAS CRAWFORD**, in moving a vote of thanks to Her Royal Highness, remarked that he had to thank her on behalf both of the professors, and of the ladies taught, for her constant interest and patronage. It was encouraging to find that a Royal Princess would give up much of her time in order to set an example to others by becoming a pupil herself. This was an age of benevolent progress, and many excellent schemes had been established, but there was none more beneficial and interesting than the extension of sanitary knowledge among the people at large.

Dr. G. V. **POORE**, who seconded the vote of thanks to Her Royal Highness, said that she was the fastest and truest friend of the Institute. He was allowed to state that her motive in attending the lectures was twofold, being a desire to encourage the spread of knowledge combined with a real interest in the subjects taught.

The vote was then carried by acclamation.

Dr. A. T. **SCHOFIELD** said that the essays written by the ladies showed a marked advance, and he advised the students to read them at mothers' meetings and country gatherings in order to reach a wider audience. Personal and domestic hygiene should form a part of the education of the women of England. He had endeavoured to move the universities to make this a subject for examination, and he had been asked to submit a scheme. With the help of The Sanitary Institute he hoped to draw up a scheme that would be satisfactory.

Professor Corfield, Sir Guyer Hunter, Sir Francis Powell, Mr. Ernest Turner, and Rev. J. Byrne also spoke on the subject.

Her Royal Highness was attended by Lady Knightley and Sir Robert Collins, and amongst those present were Professor Robinson, Dr. L. Parkes, Dr. J. F. J. Sykes, Lady Galton, Lady Crawford, and Lady Priestley.

SESSIONAL MEETING.

A Sessional Meeting of the Institute was held on April 11th, when a paper was read by Lewis H. Isaacs, F.R.I.B.A., on the "Construction of roads and steeets from a Sanitary point of view" (see page 137). About 120 Members, Associates and visitors attended.

LECTURES ON METEOROLOGY IN RELATION TO HYGIENE.

The series of six lectures arranged in conjunction with the Royal Meteorological Society were given on April 23rd, 26th, 30th, and May 3rd, 7th and 10th (see page 157). There was an average attendance of forty at each lecture.

EXAMINATIONS.

An examination for Local Surveyors was held in London on June 1st and 2nd. 35 candidates presented themselves; 15 candidates were certified to be competent as regards their sanitary knowledge, to discharge the duties of Local Surveyors.

The Council have decided to discontinue the examination for Local Surveyors.

Examinations for Inspectors of Nuisances were held in the following towns:—

London, April 6th and 7th. 126 candidates presented themselves; 61 were certified to be competent as regards their sanitary knowledge to discharge the duties of Inspectors of Nuisances.

Durham, April 27th and 28th. 26 candidates presented themselves; 18 were certified. The Medical Officer of Health, Durham County Council, attended as visitor.

Bristol, May 4th and 5th. 20 candidates presented themselves: 11 were certified. The Medical Officer of Health attended as visitor.

Hull, May 25th and 26th. 25 candidates presented themselves; 17 candidates were certified. The Chairman, Hull Sanitary Committee, and the Medical Officer of Health, Hull, attended as visitors.

Plymouth, June 22nd and 23rd. 17 candidates presented themselves; 5 were certified. The Chairman of the Health Committee and the Medical Officer of Health, Plymouth, attended as visitors.

ADDITIONAL PREMISES OF THE INSTITUTE.

The purchase of a house at 72, Margaret Street, has now been completed, and the premises are being adapted to the purposes of the Institute. The house adjoins the present museum and has been made to communicate with it. There is sufficient accommodation in the house for offices, library and reading room, committee rooms, and testing laboratories; this will enable the council to extend the work of the Institute which has been much hampered for want of suitable accommodation. The removal of the library and offices from the present building will moreover afford an opportunity for extending the museum which will be of very great advantage.

FORTHCOMING MEETINGS OF THE INSTITUTE.

LECTURES AND DEMONSTRATIONS TO SANITARY OFFICERS.

The next Course of Lectures will commence early in October. Full particulars will be published in the next Journal.

CALENDAR FOR JULY AND SEPTEMBER.

JULY.

2 M. Exhibition Committee, 5 p.m.
6 F. }
7 S. } Examination for Sanitary Inspectors, Norwich.
11 W. Finance Committee, 4 p.m.; Council Meeting, 5 p.m.
16 M. Congress Committee, 5 p.m.
20 F. Meeting of Examination Committee, 5 p.m.
23 M. Museum Committee, 5 p.m.
27 F. }
28 S. } Examination for Sanitary Inspectors, Birmingham.

SEPTEMBER.

24 M. }
25 T. }
26 W. } Congress and Exhibition, Liverpool. For the Meetings that will be
27 Th. } held each day, see page 320.
28 F. }
29 S. }

THE

FOURTEENTH CONGRESS,

WILL BE HELD AT

LIVERPOOL,

From SEPTEMBER 24th to 29th, 1894.

GENERAL ARRANGEMENTS.

ADDRESSES AND LECTURES.

Inaugural Address by the President.
Lecture to the Congress.
Address to the Working Classes.

SECTIONAL MEETINGS.

Section I.—Sanitary Science and Preventive Medicine.
Section II.—Engineering and Architecture.
Section III.—Chemistry, Meteorology and Geology.

CONFERENCES.

On the Sanitation of the Passenger and Mercantile Marine Service.
Medical Officers of Health.
Municipal and County Engineers.
Sanitary Inspectors.
Ladies on Domestic Hygiene.
Receptions and Excursions.

EXHIBITION.

An Exhibition of Apparatus and Appliances relating to Health and Domestic Comfort will be held.

PAPERS AND DISCUSSIONS.

The Council invite Papers on subjects relating to Health and Sanitary Science. Papers are limited to twenty minutes in reading. A short abstract must accompany every Paper, both for the convenience of the Press at the Congress and for insertion, subject to the approval of the Council, in the Journal of the Institute, should it not be deemed desirable to publish the Paper *in extenso*. No previously published Paper can be read. The acceptance of Papers, and the days on which they are to be read, are determined by the Council before the beginning of the Meeting. The Council reserve the right of refusing any Papers sent in; and in the case of those accepted, the reading of them must depend on the time at the disposal of the Meeting. Papers read at the Congress cannot be published by the Authors, except by permission of the Council. The Council reserve to themselves the privilege of printing any Paper read at the Congress, either wholly or in part, or of refraining from the publication thereof, if they see fit.

The Addresses and Papers or Abstracts thereof are usually printed by the Institute in London before the meeting of the Congress, and may be purchased from the Secretary of the Institute during the Congress. Authors should forward their manuscript by book post *on or before August 24th*, addressed to the Secretary, Sanitary Institute, Parkes Museum, Margaret Street, London, W.

RECEPTION ROOM AND PLACES OF MEETING.

A Reception Room will be opened at the UNIVERSITY COLLEGE, BROWNLOW HILL, on MONDAY, SEPTEMBER 24th, at 11 a.m., and on the following days at 9 A.M. for the issue of all Tickets in connection with the Congress.

The Inaugural Address of the President and the Lectures to the Congress will be given in University College.

The Sectional Meetings, General Meetings, and Conferences will be held in University College.

The Address to the Working Classes will be given in the Picton Lecture Hall.

HOTEL AND LODGING ACCOMMODATION, AND TRAVELLING ARRANGEMENTS

Will be determined by the Local Committee, and information relating to the same may be obtained from the Honorary Local Secretaries, Municipal Buildings, Liverpool, or at the Reception Room.

TICKETS.

Fellows, Members, and Associates of the Institute are supplied with Tickets for the Congress on application to the Secretary before the Congress, or may be obtained at his Office in University College during the Meeting.

To those not Members or Associates of the Institute Congress Tickets will be issued, entitling the holder to the use of the Reception Room, to admission to the Presidential and other Addresses, to all Meetings, to the Exhibition of the Institute, and to any Conversazione given by the Institute. The price of the Congress Tickets is Half-a-guinea each. These Tickets may be obtained from the Secretary of the Institute, or at the Office of the Hon. Local Secretaries.

VISITS AND EXCURSIONS.

Particulars of these will be published in a later Programme, and Tickets and List of Places to be visited can be obtained at the Office in the Reception Room.

Officers of the Congress.

President.

SIR FRANCIS SHARP POWELL, BART. M.P.

Vice-Presidents.

Rt. Hon. WILLIAM B. BOWRING (Lord Mayor of Liverpool).
Rt. Rev. The BISHOP of LIVERPOOL.
Rt. Rev. The BISHOP of CHESTER.
SIR WILLIAM BOWER FORWOOD, J.P.
SIR EDWARD R. RUSSELL.
SIR THOMAS BROCKLEBANK, J.P., BART.
Rt. Hon. BARON HENRY DE WORMS, P.C., F.R.S., D.L., J.P., M.P.
SIR GEORGE SMYTH BADEN-POWELL, K.C.M.G., M.A., F.R.S.S., M.P.
WILLIAM FREDERICK LAWRENCE, M.A., J.P., M.P.
RALPH NEVILLE, Q.C. M.A., M.P.
WALTER HUME LONG, M.P.
ROBERT PATERSON HOUSTON, M.P.
Col. SANDYS, M.P.
THOMAS SNAPE, M.P.
The MAYOR of BIRKENHEAD.
The MAYOR of BOOTLE
The MAYOR of SOUTHPORT.
WILLIAM ADAMSON.
W. MITCHELL BANKS, F.R.C.S.
W. BARTLETT, C.C.
JOHN BRANCKER, J.P. (Chairman Dock Board).
JOHN CAMERON, M.D.
RICHARD CATON, M.D.
ALEXANDER DAVIDSON, M.A., M.D.
Col. DAVID GAMBLE, C.B.
H. B. GILMOUR, J.P.
T. R. GLYNN, M.D.
Prof. F. GOTCH, F.R.S.
THOMAS HOLDER, J.P.
CANON MAJOR LESTER, M.A. (Chairman of School Board).
Prof. OLIVER LODGE, F.R.S.
Rev. T. W. M. LUND, M.A.
Rt. Rev. MON. NUGENT.
WILLIAM RADCLIFFE, J.P.
PRINCIPAL G. H. RENDALL, M.A.
T. E. SAMPSON, J.P. (Coroner).
JOSHUA SING, J.P.
W. J. STEWART, J.P. (Stipendiary Magistrate).
A. T. H. WATERS, M.D.
Rev. JOHN WATSON, M.A.
W. H. WATTS, J.P.

ARGENTINE REPUBLIC, CONSUL FOR ...	FRANCISCO P. HANSEN.
FRANCE	A. LAURENT COCHELET.
GUATEMALA REPUBLIC	MAXIMILLIAN NACKMANN.
HAYTI REPUBLIC	W. L. ROBERTS.
LIBERIA REPUBLIC	J. DUNBAR KELLY.
PORTUGAL	BARON DE ROUSSADO
SPAIN	ENRIQUE MEDIANO.
SWEDEN AND NORWAY	HARALD EHRENBORG.
URUGUAY REPUBLIC	ENRIQUE DAUBER.

Hon. Local Treasurer.

GEORGE H. SHIPLEY, Bank of Liverpool (Heywood's Branch).

Hon. Local Secretaries.

H. PERCY BOULNOIS, M.INST.C.E., CITY ENGINEER, } MUNICIPAL BUILDINGS, LIVERPOOL.
E. W. HOPE, M.D., D.SC., MEDICAL OFFICER OF HEALTH. }

THE PRESIDENT, AND VICE-PRESIDENTS,

WITH THE FOLLOWING, FORM THE

Local General Committee.

The LORD MAYOR OF LIVERPOOL (The Right Honorable WILLIAM B. BOWRING) *Chairman*

The Rev. W. J. ADAMS.
WILLIAM ADAMSON.
The Rev. C. F. AKED.
J. EDWARD ANDERSON.
R. S. ARCHER, M.D.
The Rev. Canon ARMOUR, D.D.
The Rev. R. A. ARMSTRONG, B.A.
GEORGE ATKIN, J.P.
SETH BACKHOUSE, R.P.
M. C. BANNISTER, ASSOC.M INST.C.E.
The Rev. A. B. BARKWAY.
W. S. BARRETT, J.P.
RICHARD BARROW.
WILLIAM BARTLETT, C.C.
R. ATWOOD BEAVER.
HENRY L. BECKWITH.
CHARLES H. BELOE, M.INST.C.E.
T. H. BICKERTON, M.R.C.S.
Colonel W. W. BIGGS.
Dr. A. M. BLIGH, C.C.
JOHN BLIGH, M.D.
ALFRED BOOTH, J.P.
Captain J. W. NOTT BOWER.
G. BRADBURY.
JOHN BRANCKER, J.P.
R. A. BRANNIGAN, M.D.
JOHN A. BRODIE, ASSOC.M.INST.C.E.
ELI BROOKS, C.C.
G. J. C. BROOM, M.INST.C.E.
EDMOND BROWNBILL, J.P.
EDGAR J. BROWNE, M.R.C.S.
J. T. BRUNNER, M.P.
W. J. BURGESS, C.C.
E. H. BUSHELL.
CHARLES BIRCHALL.
HERBERT CAMPBELL, J.P.
WILLIAM CARTER, M.D., B.SC., LL.D.
H. C. CHAPMAN, M.R.C.S., B.SC.
HARCOURT E. CLARE.
The Ven. Archdeacon CLARKE.
Dr. THOMAS CLARKE, C.C.
WILLIAM CLARKSON, J.P.
ALFRED CORNETT.
S. B. COTTRELL, ASSOC.M.INST.C.E.
J. D. CRAWFORD, M.R.C.S.
WILLIAM CROSFIELD, M.P.
ALFRED CULSHAW, F.R.I.B.A.
C. H. DARBISHIRE, J.P., ASSOC.M INST.C.E.
ALFRED T. DAVIES.
T. MOORE DAWSON, M.R.C.S.
C. STEWART DEAN, C.C.
T. DONNELLY, C.C.
J. A. DOUGHAN, J.P.
JOHN DUNCAN.
The Rev. FRANK DYSON, M.A.
T. O. EASTON, J.P.
E. SHORROCK ECCLES.
Colonel C. O. ELLISON, V.D., J.P.
EDWARD EVANS, Jnr.
GEORGE FARREN, J.P.
ALFRED FLETCHER, J.P.
T. J. FLYNN, C.C.
Sir WILLIAM B. FORWOOD, J.P.
Colonel DAVID GAMBLE, C.B.
J. E. GEMMELL, M.B.
HAMILTON B. GILMOUR, J.P.
Professor GOTCH, M.A., F.R.S.
G. E. GRAYSON, F.R.I.B.A.
C. W. GREEN.
GEORGE GRIERSON, C.C.
Alderman E. GRINDLEY.
KARL A. GROSSMAN, M.D.
GEORGE HAMILTON, F.R.C.S.
E. M. HANCE, LL.B., L.C.P.
T. HARNETT HARRISSON, F.R.I.B.A., ASSOC.-M.INST.C.E.
HENRY HARTLEY, F.R.I.B.A.
A. E. HAWKES, M.D.
Alderman H. C. HAWLEY, J.P.
JAMES M. HAY.
J. D. HAYWARD, M.D.
P. E. J. HEMELRYK, J.P.
Professor HELE-SHAW, M.INST.C.E.
JOHN HENDERSON, J.P.
THOMAS HOLDER, J.P.
A. HILL HOLME, J.P.
G. G. HOLME.
GEORGE HOLME.
ALFRED HOLT, M.INST.C.E.
H. H. HORNBY, J.P.
JOHN HOULDING, C.C.
JOSEPH HOULT, C.C.
ALFRED HUGHES, M.A.
T. H. ISMAY, J.P., D.L.
The Rev. L. P. JACKS, M.A.
HENRY JEVONS, J.P.
T. R. JOB, J.P.
R. E. JOHNSTONE, M.INST.C.E.
H. R. JONES, M.A., M.D.
MORRIS P. JONES, J.P.
THOMAS KELLY, C.C.
WILLIAM KING, M.INST.C.E.
EDMUND KIRBY, F.R.I.B.A.
WILLIAM KIRK.
CHARLES LANCASTER.
T. D. LAURENCE.
W. F. LAWRENCE, M.A., M.P.
CHARLES LAYCOCK.
JOHN LEA.
F. J. LESLIE.
Rev. Canon T. MAJOR LESTER, M.A.
H. M. LIARDET, R.N.
DAVID LLOYD, R.P.
J. R. LOGAN, M.B.
F. W. LOWNDES, M.R.C.S.
Rev. T. W. M. LUND, M.A.
G. J. LYNSKEY, C.C.
G. FOSBERY LYSTER, M.INST.C.E.
THE MAYOR OF BIRKENHEAD
(BENEDICT JONES, B.A.)
THE MAYOR OF BOOTLE
(BENJAMIN S. JOHNSON).
C. MACALISTER, M.B.
Professor J. M. MACKAY, M.A.
Rev. T. J. MADDEN.
H. D. MATHIAS, R.P.
M. H. MAXWELL, Junr., C.C.
Alderman F. J. McADAM.

Local General Committee—*continued.*

C. McARDLE.
C. M'ARTHUR.
Dr. J. G. McCANN, C.C.
S. McMILLIN, C.C.
H. W. MEADE-KING, J.P.
R. R. MEADE-KING, C.C.
THOMAS MENLOVE, J.P.
THOMAS MERCER.
ISAAC MORRIS, J.P.
G. H. MORTON, Junr.
S. K. MUSPRATT, J.P.
Rev. J. K. NUTTALL.
T. BANNER NEWTON.
Right Rev. Monsignor NUGENT.
Alderman T. W. OAKSHOTT, J.P.
COARD S. PAIN, ASSOC.INST.C.E.
JOSEPH PARRY, M.INST.C.E.
J. R. PATON.
W. S. PATTERSON.
EDWARD PAULL, J.P.
THOMAS PEGRAM.
WM. PERMEWAN, M.D.
W. H. PICTON, C.C.
C. PETRIE, C.C.
W. E. PLUMMER, M.A., F.R.A.S.
Rev. Canon POSTANCE, M.A.
JOHN PRICE, ASSOC.M.INST.C.E.
CHARLES J. PROCTER.
Sir DAVID RADCLIFFE, J.P.
Alderman WILLIAM RADCLIFFE, J.P.
Alderman P. H. RATHBONE, J.P.
Principal G. H. RENDALL, M.A.
R. S. REYNOLDS, M.R.C.V.S.
H. S. RICHMOND.
RICHARD RIPLEY, C.C.
N. E. ROBERTS, M.B.
WILLIAM ROBERTS, C.C.
R. ROBERTSON, M.D.
C. A. ROWLANDSON, M.INST.C.E.
Alderman RUDDIN, J.P.
T. W. RUNDELL.
Sir EDWARD R. RUSSELL.
Rev. Canon DYSON RYCROFT, M.A.
T. E. SAMPSON, J.P.
ALBERT H. SAMUEL.
Lieutenant-Colonel T. M. SANDYS, M.P.
JOHN SCOTT, C.C.
Dr. G. SCHACK-SOMMER.
EDWARD SERGEANT, M.R.C.S.
T. MYDDLETON SHALLCROSS.
C. H. B. SHEARS, M.R.C.S.
THOMAS SHELMERDINE, Junr.
JOSHUA SING, J.P.
DAVID SMART, M.B., B.SC.
Alderman F. SMITH.
SIMEON SMITH, C.C.
THOMAS SNAPE, M.P.
THEODOR A. VON SOBBE
J. BARKELEY SMITH, J.P.
Colonel SPENCELY, V.D.
G. W. STEEVES, M.D.
A. STOOKES, M.B.
Rev. ALEXANDER STEWART, M.A.
W. J. STEWART, J.P.
J. G. TAGGART, C.C.
Rev. JOHN THOMAS, M.A.
Rev. J. DENTON THOMPSON, M.A.
NATHANIEL TOPP, C.C.
FRANCIS VACHER, F.R.C.S.
EPHRAIM WALKER, C.C.
HORACE WALKER.
W. H. WATTS, J.P.
A. T. H. WATERS, M.D.
Rev. JOHN WATSON, M.A.
H. H. WEST, M.INST.C.E.
GEORGE WESTRY, M.R.C.P.
WILLIAM WHITFORD, M.D.
Colonel C. A. WHITNEY, V.D.
GLYNN WHITTLE, M.A., M.D.
A. C. WILBY, R.P.
RICHARD WILLIAMS, M.R.C.S.
W. E. WILLINK, J.P.
Colonel T. WILSON, V.D.
J. T. WOOD, M.INST.C.E.
JAMES WORRALL, R.P.
GEORGE WYNNE.

GEORGE H. SHIPLEY, *Hon. Treasurer.*

H. PERCY BOULNOIS, M.INST.C.E., *Hon. Sec.*

E. W. HOPE, M.D., D.SC., *Hon. Sec.*

Lady Members.

THE LADY MAYORESS (MRS. W. B. BOWRING).

Miss BARR.
Mrs. ALFRED BOOTH.
Mrs. H. P. BOULNOIS.
Miss FANNY CALDER.
Miss A. J. DAVIES.
Mrs. S. E. DRYSDALE.
Mrs. E. SHORROCK ECCLES
Mrs. A. J. FAIRRIE.
Miss M. M. GRAHAM
Mrs. J. HADDOCK.
Miss RATHBONE.
Mrs. G. H. RENDALL.
Mrs. J. SEPHTON.
Mrs. G. W. STEEVES.

County Councils, Corporations, and Local Authorities, who have appointed Delegates to the Congress.

THE COUNTY COUNCILS OF:

Anglesey.
Cambridge.
Cheshire.
Derbyshire.
Dumfries.
Durham.
Elgin.
Essex.
Flintshire.
Forfar.
Haddington.
Lancashire.
Lindsey, Lincolnshire.
Merioneth.
Nottingham.
North Riding, Yorks.
Southampton.
Surrey.
Staffordshire.
Stewartry and Kirkcudbright.
Wiltshire.
Worcester.
Wigtownshire.
West Riding, Yorks.

THE COUNTY BOROUGHS OF:

Belfast.
Birkenhead.
Birmingham.
Blackburn.
Bolton.
Bootle.
Bristol.
Burnley.
Bury.
Cork.
Dublin.
Dundee.
Exeter.
Glasgow.
Halifax.
Hanley.
Huddersfield.
Leeds.
Lincoln.
Liverpool.
Middlesbrough.
Preston.
Plymouth.
Rochdale.
Salford.
St. Helens.
Sunderland.
West Ham.
West Bromwich.
Wolverhampton.

THE URBAN SANITARY AUTHORITIES OF:

Abram.
Armagh.
Ballymena.
Barry and Cadoxton.
Birkdale.
Blackpool.
Brigg.
Brighouse.
Bromborough.
Bromley.
Caerphilly.
Cambridge.
Carlisle.
Carnarvon.
Clitheroe.
Colne and Marsden.
Congleton.
Cowbridge.
Crewe.
Darwen.
Eastbourne.
Eccles.
Farnworth.
Garston.
Gillingham.
Godalming.
Gorton.
Hackney Vestry.
Heywood.
Holyhead.
Hoole.
Horwich.
Hoylake & West Kirby.
Hull.
Kearsley.
Kidderminster.
Leigh.
Lewes.
Linlithgow.
Litherland.
Llandudno.
Longton.
Macclesfield.
Maidstone.
Mansfield.
Margam.
Middlewich.
Much Woolton.
Nelson.
Newcastle-und.-Lyme.
Northwich.
Paddington Vestry.
Radcliffe.
Rawtenstall.
Rhymney.
Runcorn.
Southport.
St. John, Hampstead Vestry.
St. Pancras Vestry.
Strand Board of Works.
Stretford.
Swindon.
Swindon New Town.
Tipton.
Toxteth Park.
Tynemouth.
Walker.
Wallasey.
Walton-on-the-Hill.
Warley.
Warrington.
Waterloo with Seaforth.
Wavertree.
Wuerdle and Wardle.
Wick.
Widnes.
Winsford.
Wrexham.

Delegates to the Congress—*Continued.*

THE RURAL SANITARY AUTHORITIES OF

Barnstaple,
Barton Regis.
Bolton.
Caistor.
Carlisle.
Carrick-on-Shannon.
Chester.
Chorley.
Clitheroe Union.
Glanford Brigg.
Hexham Union.
Holywell.
Lincoln.
Mutford & Lothingland.
Ormskirk.
Prescot.
Shardlow.
St. Asaph.
Wirrall.
Wrexham Union.

Accrington and Church Outfall Sewerage Board.
Birkdale School Board.
Chester Port Sanitary Authority.
Hull & Goole Port Sanitary Authority
Pembroke Township.
Port of London Sanitary Authority.
Shillelagh Union.

Societies who have appointed Delegates to the Congress.

British Institute of Preventive Medicine.
Dublin Sanitary Association.
Institute of Certificated Sanitary Inspectors.
Institute of Chemistry.
Institution of Electrical Engineers.
Irish Medical Association.
Ladies' Sanitary Association.
North Western Society of Medical Officers of Health.
Royal College of Physicians.
Royal College of Surgeons.
Royal Institute of British Architects.
Royal Meteorological Society.
Sanitary Inspectors' Association.
Sanitary Inspectors' Association, North West District.
Ulster Sanitary Association.

Proceedings of the Congress and Officers of Sections and Conferences.

ADDRESSES AND LECTURES.

Inaugural Address to the Congress

BY Sir FRANCIS SHARP POWELL, BART., M.P.
to be given in UNIVERSITY COLLEGE, *on Monday, September 24th, at* 3 *p.m.*

Lecture to the Congress

BY GEORGE BLUNDELL LONGSTAFF, M.A., M.D.OXON., F.R.C.P.
to be given in UNIVERSITY COLLEGE, *on Tuesday, September 25th, at* 8 *p.m.*

Address to the Working Classes

BY SIR JAMES CRICHTON BROWN, M.D., LL.D., F.R.S.
to be given in THE PICTON LECTURE HALL, *on Friday, September 28th, at* 8.30.

- - -

SECTIONAL MEETINGS.

Section I.—"Sanitary Science and Preventive Medicine."

Wednesday, September 26th, to be held in UNIVERSITY COLLEGE.

President.

EDWARD E. KLEIN, M.D., F.R.S.

Vice-Presidents.

WILLIAM CARTER, M.D., B.SC., LL.B.
R. SYDNEY MARSDEN, M.B., D.SC., F.I.C., F.C.S., F.R.S.E.
ARTHUR RANSOME, M.A., M D., F.R.S.

Hon. Secretaries.

J. F. J. SYKES, M.D., D.SC. | A. JASPER ANDERSON, M.A., M.B., M.R.C.S., D.P.H.
HERBERT PECK, L.R.C.P., D.P.H.

Section II.—" Engineering and Architecture."

Thursday, September 27th, to be held in UNIVERSITY COLLEGE.

President.

G. F. DEACON, M.INST.C.E.

Vice-Presidents.

SIR DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.
CHARLES H. BELOE, M.INST.C.E.
HENRY HARTLEY, F.R.I.B.A.

Hon. Secretaries.

MAJOR LAMOROCK FLOWER. | W. HOWARD-SMITH, ASSOC.M.INST.C.E.
EDMUND KIRBY, F.R.I.B.A. | COARD S. PAIN. F.S.I., ASSOC.INST.C.E.

Section III.—"Chemistry, Meteorology, and Geology."

Friday, September 28th, to be held in University College.

President.

Thomas Stevenson, M.D., F.R.C.P., M.R.C.S., Scientific Analyst to the Home Office.

Vice-Presidents.

Prof. J. Campbell Brown, D.Sc.
Prof. W. A. Herdman, D.Sc., F.R.S., F.R.S.E.
Prof. Edward Hull, M.A., F.G.S., LL.D., F.R.S.

Hon. Secretaries.

G. J. Symons, F.R.S.
W. E. Plummer, M.A., F.R.A.S.
H. O. Forbes, LL.D., F.R.G.S., M.A.I.

CONFERENCES.

On the Sanitation of the Passenger and Mercantile Marine Service.

Tuesday, September 25th, to be held in University College.

President.

Sir William Bower Forwood, J.P.

Vice-Presidents.

Henry E. Armstrong, D.Hy., M.R.C.S.
W. H. Collingbridge, M.A., M.D.
D. S. Davies, M.D., D.P.H.
A. Wellesley Harris, M.R.C.S., D.P.H.
Samuel Hough, J.P., C.C.
Joseph Hoult, C.C.
J. M'Diarmid.
J. Wright Mason, M.B., M.R.C.S., D.P.H.
Austin Taylor, C.C.
F. M. Williams, M.R.C.S., D.P.H.

Hon. Secretary.

Nathaniel Edward Roberts, M.B., C.M.

This Conference is open to all engaged in the Passenger and Mercantile Marine Service.

Medical Officers of Health.

Tuesday, September 25th, to be held in University College.

President.

Charles E. Paget, M.R.C.S., D.P.H.

Vice-Presidents.

F. W. Barry, M.D., B.Sc., F.R.S.E.
J. Spottiswoode Cameron, M.D., B.Sc.
Alfred Hill, M.D., F.R.S.E., F.I.C.
James B. Russell, M.D., LL.D.
Edward Sergeant, L.R.C.P., M.R.C.S.
T. W. Thompson, M.R.C.S.

Hon. Secretaries.

Philip Boobbyer, M.B., M.R.C.S.
John Robertson, M.D., B.Sc.

This Conference is open to all Medical Officers of Health.

Municipal and County Engineers.

Tuesday, September 25*th, to be held in* UNIVERSITY COLLEGE.

President.
A. M. FOWLER, M.INST.C.E.

Vice-Presidents.
GEO. J. C. BROOM, M.INST.C.E., F.G.S. | JOHN T. EAYRS, M.INST.C.E., F.S.I.

Hon. Secretaries.
JOHN PRICE, ASSOC.M.INST.C.E., F.S.I. | J. A. CROWTHER.

This Conference is open to all Municipal and County Engineers.

Sanitary Inspectors.

Tuesday, September 25*th, to be held in* UNIVERSITY COLLEGE.

President.
FRANCIS VACHER, F.R.C.S., M.R.C.P., F.C.S.

Vice-Presidents.
G. WALTER STEEVES, B.A., M.D., M.R.C.S.
H. THOMAS (Chairman of Council, Sanitary Inspectors' Assoc.)
W. H. MAY (Chairman of Council, Inst. of Certificated Sanitary Inspectors).
J. COOPER (Sanitary Inspector, Liverpool).

Hon. Secretaries.
E. WORRALL. | ALBERT TAYLOR.

This Conference is open to all Sanitary Inspectors and Inspectors of Nuisances.

Domestic Hygiene.

Tuesday, September 25*th, to be held in* UNIVERSITY COLLEGE.

President.
THE LADY MAYORESS (Mrs. W. B. BOWRING).

Vice-Presidents.
Mrs. A. BOOTH. | Miss FLORENCE MELLY.
Mrs. J. HADDOCK. | Mrs. G. H. RENDALL.
Miss J. MEADE-KING | Mrs. WATERHOUSE.
Mrs. A. T. H. WATERS.

Hon. Secretaries.
Mrs. BOULNOIS. | Miss FANNY CALDER.

This Conference is open to all Ladies.

Order of Proceedings.

MONDAY, SEPTEMBER 24TH.

1 p.m.—**Reception of the Members of the Congress.**

1.30 p.m.—**Public Luncheon.**

3 p.m.—**Inaugural Address to the Congress.**

8 p.m.—**Opening of the Exhibition in the Drill Hall,**

TUESDAY, SEPTEMBER 25TH.

10.30 to 5 p.m.—**Conferences in University College.** *(See pages* 318 *&* 319*)*.

8 p.m.—**Lecture to the Congress in University College.**

WEDNESDAY, SEPTEMBER 26TH.

10.30 to 5 p.m.—**Meeting of Section I.** *(See page* 317*)*. **President's Address and Papers and Discussions on "Sanitary Science and Preventive Medicine."**

Note.—Papers and Discussions will be continued on the following day.

THURSDAY, SEPTEMBER 27TH.

10.30 to 5 p.m.—**Meeting of Section II.** *(See page* 317*)*. **President's Address and Papers and Discussions on "Engineering and Architecture."**

Note.—Papers and Discussions will be continued on the following day.

FRIDAY, SEPTEMBER 28TH.

10.30 to 5 p.m.—**Meeting of Section III.** *(See page* 318*)*. **President's Address and Papers and Discussions on "Chemistry, Meteorology, and Geology."**

5 p.m.—**Closing General Meeting of the Congress.**

8.30 p.m.—**Address to the Working Classes in the Town Hall.**

Excursions and Visits to places of interest will be made during the Congress.

[Particulars will be given in future Programmes.]

THE HEALTH EXHIBITION

WILL BE HELD IN

THE DRILL HALL,

UPPER WARWICK STREET,

LIVERPOOL.

From SEPTEMBER 24th to OCTOBER 20th, 1894.

The Exhibition is held in connection with the Fourteenth Autumn Congress of The Sanitary Institute, and includes Sanitary Apparatus and Appliances, and Articles for Domestic Use and Economy.

Applications for Space must be made on the Official Form and under the proper class. They must be sent to Mr. W. H. Knight, the Curator of the Exhibition, at the Offices of the Institute, Margaret Street, London, W., not later than Saturday, August 25th, 1894.

The Scale of Charge for Floor Space will be 15s. per Foot frontage, with a depth of six feet. Corners and Special Places will be charged at higher rates. Wall space, 1s. per square foot. No Floor Space will be allotted for less than three feet frontage, or Wall Space for less than five square feet. *All charges must be paid at the time of allotment.*

Medals and Certificates of Merit will be awarded at the discretion of the Judges, and their decisions will in all cases be final. It is intended to announce as many Awards as practicable at a Special Meeting to be held during the Exhibition. A complete classified and Illustrated List of Exhibits to which Awards have been given by the Institute is published.

Protection in accordance with the Patents, Designs, and Trade Marks Act, 1883, has been obtained from the Board of Trade for persons desirous of exhibiting New Inventions.

Forms of Application for Space and other particulars can be obtained of the Curator.

FELLOWS, MEMBERS, & ASSOCIATES ELECTED,

From April to June, 1894, inclusive.

FELLOWS (Fellow San. Inst.)

Reg. No.	Date of Election.	
90	1894. Apr.	Cooper, Francis Alfred, *Director of Public Works and Resident Engineer, Hong Kong (c/o H. F. Cooper, Nottingham and Notts Bank, Newark).*
784	1894. Apr.	Hunter, John, 9, *Lincoln's Inn, W.C.*
783	1894. Apr.	Turner, Rev. Samuel William, *Little Ellingham, Norfolk.*

MEMBERS (Mem. San. Inst.)

† Passed Examination as Local Surveyor.

823	1894. June.	Barnes, Robert, M.D., *Lingwood, Lyss, Hampshire.*
820	1894. June.	Brown, Joseph William, ASSOC.M.INST.C.E., *Borough Engineer, Municipal Buildings, West Hartlepool, Durham.*
816	1894. Apr.	Chadwick, Osbert, C.M.G., 11, *Airlie Gardens, Campden Hill, W.*
817	1894. Apr.	Elkington, Surg.-Capt. Henry Percival George, D.P.H., *Army Medical Staff, Station Hospital, Eastbourne, Sussex.*
821	1894. June.	Findlay, Robert, ASSOC.M.INST.C.E., *District Surveyor, Eltham Green, Eltham, S.E.*
818	1894. Apr.	‡†Fraser, William, ASSOC.M.INST.C.E., 276, *Cowbridge Road, Cardiff.*
822	1894. June.	Gloyne, Robt. Maynard, ASSOC.M.INST.C.E., *Borough Engineer, Town Hall, Eastbourne.*
824	1894. June.	Hall, Joseph, ASSOC.M.INST.C.E., *Borough and Water Engineer, Municipal Buildings, Cheltenham.*
825	1894. June.	Hamilton, Col. H. B., *United Service Club, Pall Mall, S.W.*
819	1894. Apr.	Hempleman, Frederick Seband, *Wennington House, Wennington, Essex.*
826	1894. June.	Roechling, Herman Alfred, 14, *Market Street, Leicester.*
827	1894. June.	Thompson, Arthur E., *Leadenhall Buildings, E.C.*
828	1894. June.	Whyatt, Henry Gilbert, ASSOC.M.INST.C.E., *Deputy Borough Engineer, Town Hall, Salford.*

ASSOCIATES (Assoc. San. Inst.)

‡ Passed Examination as Inspector of Nuisances.

933	1894. May.	‡Abbott, Walter, 71, *Green Lane, Hanwell, W.*
927	1894. May.	‡Atkinson, Gordon Campbell, 16, *Highbury Place, Islington, N.*
921	1894. Apr.	‡Axtell, Alfred, 1, *Gloucester Road, S.W.*
928	1894. May.	‡Bailey, George, 159, *Parrock Street, Gravesend, S.E.*

Reg. No. Date of Election.

924 1894. Apr. ‡Bailey, Robert, 4. *Elm Grove, Berkhamstead, Herts.*
929 1894. May. ‡Baker, Alfred Augustus, *Engineer's House, Public Baths, St. George's East, E.*
923 1894. Apr. ‡Barker, Herbert, 43, *Meeson Road, West Ham, E.*
930 1894. May. ‡Bradley, William Lawrence, *St. Peter's Estate, Tunbridge Wells, Kent.*
953 1894. June. ‡Brooking, Richard Alfred, *Meadowbrook, Sheen Road, Richmond, Surrey.*
950 1894. May. ‡Callow, Samuel, 20, *Donaldson Road, Kilburn, N.W.*
931 1894. May. ‡Cassirer, Mrs. C. Jennie, *York House*, 1b, *Upper Baker Street, N.W.*
932 1894. May. ‡Clegg, Walter Charles, 25, *Alfred Place, Bedford Square, W.C.*
971 1894. June. ‡de Chaumont, Miss Nora Tempest François, *Woolston Lawn, Southampton.*
960 1894. June. ‡Dove, Henry Montague, 97, *Sotheby Road, Highbury Park, N.*
933 1894. May. ‡Downes, George Edward, 2, *St. Andrew's Hill, E.C.* (35, *Springdale Road, Green Lanes, N.*)
916 1894. May. ‡Duncan, Miss Annie Jane, *Church of England Grammar School, Launceston, Tasmania* (*c/o Messrs. Woodhead & Co.*, 44, *Charing Cross, S.W.*)
972 1894. June. ‡Edmonds, Walter, 25, *Clive Road, Rochester, Kent.*
961 1894. June. ‡Elcum, Miss Hannah Jane, 27, *Hilldrop Crescent, Camden Road, N.*
936 1894. May. ‡Esau, Henry William, 6, *King's Place, Portman Square, W.*
962 1894. June. ‡Fussell, Thomas, 34, *Thayer Street, Manchester Square, W.*
963 1894. June ‡Gander, Henry, *London Road, Shipston-on-Stour, Worcestershire.*
935 1894. May. ‡Green, Arthur A., 4, *Souvenir Terrace, Eastfield Road, Peterborough.*
934 1894. May. ‡Goslett, Mrs. Clare M., *Linden, Babbacombe, Devon.*
938 1894. May. ‡Haynes, Miss Catherine, 24, *Rawson Road, Seaforth, Liverpool.*
964 1894. June. ‡Hough, Josiah, 43, *Neville Road, Croydon, S.W.*
965 1894. June. ‡Hulse, James Henry, 15, *Great Alie Street, E.*
Kentish Town, N.W.
937 1894. May. ‡Johnson, Henry, 62, *Reaston Street, New Cross, S.E.*
973 1894. June. ‡Jones, Joseph, *Local Board, Eccleshill, Yorks.*
947 1894. May. ‡Levy, Jacob, 51, *Gainston Road, Nottingham.*
966 1894. June. ‡Luetchford, George Harry, 26, *Kelly Street,*
967 1894. June. ‡Macdonald, George Hunter, 16, *Salisbury Street, Bedford.*
974 1894. June. ‡March, George Samuel James, 5, *Harcourt Road, Wimbledon, S.W.*
951 1894. May. ‡Martin, Charles, *Hill Road, Sutton, Surrey.*

Reg. No. Date of Election.

952 1894. May. ‡Mills, Herbert, 15, *Overstone Road, Hammersmith, W.*

957 1894. May. ‡Morgan-Browne, Miss Hilda K., 46, *Ridgmount Gardens, Gower Street, W.C.*

924 1894. Apr. Morrison, James Wilson, M.A.EDIN., 11, *Osborne Terrace, Edinburgh.*

914 1894. May. ‡Owner, Joseph, 49, *Beatrice Road, Bermondsey, S.E.*

934 1894. May. ‡Peck, Arthur David, 9, *Croydon Road, Beckenham, Kent.*

919 1894. May. ‡Peers, John, 1, *Grasmere Street, Lower Broughton, Lancashire.*

951 1894. May. ‡Prestoe, Henry William, 21, *Caldervale Road. Clapham Park, S.W.*

964 1894. June. ‡Priest, Alfred, 64, *Elswick Road, Lewisham, S.E.*

969 1894. June. ‡Ray, Ernest Edward, 31, *Henslowe Road, East Dulwich, S.E.*

939 1894. May. ‡Reeve, Isaac, *Imperial Park, Beeston, Nottingham.*

975 1894. June. ‡Robbins, Francis Joseph, *Sewers Office, Guildhall, E.C.*

940 1894. May. ‡Roberts, Edwin Owen, 68, *Denbigh Street, Pimlico, S.W.*

941 1894. May. ‡Sheppard, Richard John, 49, *Broke Road, Dalston, N.*

942 1894. May. ‡Squire, Miss Rose Elizabeth, *Danescombe, Creffield Road, Ealing, W.*

976 1894. June. ‡Stake, Tom, *Perseverance Cottages, Stanningley, Leeds.*

970 1894. June. ‡Thomas, William Henry, *Hill View, Windmill Lane, Tring, Herts.*

943 1894. May. ‡Tugwell, Horace, 4, *Belsize Crescent, Hampstead, N.W.*

925 1894. Apr. Vernon, George, 21, *Probert Road, Brixton, S.W.*

944 1894. May. ‡Westwick, Louis Alfred, *West Hill Drive, Mansfield, Notts.*

955 1894. May. ‡Wheeler, John Henry West, 189, *Fulham Road. Chelsea, S.W.*

977 1894. June. ‡Whitbread, Richard, *Prospect Villa, Carlton, Nottingham.*

978 1894. June. ‡Williams, Evan John, 13, *Pimhill Street, Toxteth Park, Liverpool.*

954 1894. May. ‡Wilson, Frederick Robert, 121, *Huddleston Road, Tufnell Park, N.*

979 1894. June. ‡Wood, Charles Edward, *The Health Offices, Chesterfield, Derby.*

945 1894. May. ‡Worthington, T. Locke, A.R.I.B.A., 23, *Queen Anne's Gate, Westminster, S.W.*

920 1894. Apr. ‡Young, James, *Inspector of Nuisances, West Boldon, Durham.*

CONTRIBUTIONS AND ADDITIONS TO LIBRARY.

April to June, 1894.

⁂ *For publications of Societies and Institutions, &c., see under "Academies."*

ACADEMIES (American).

American Society of Civil Engineers. Transactions, Vol. XXIX., Part I. and II. International Engineering Congress, Chicago, 1893. 1,459 p., 8vo. New York, 1893. *The Society.*

Chicago. Proceedings of Section E of the Worlds Engineering Congress, 1893, being Vol. I. of the Proceedings of the Society for the Promotion of Engineering Education. 342 p., 8vo. Chicago, 1893. *Western Society of Engineers.*

New York *Academy of Medicine.* Transactions of Second Series, Vol. IX., 1892. 408 p., 8vo. New York, 1893. *The Academy.*

Ontario. *Assoc. of Executive Health Officers.* Report of the Fifth Annual Meeting held at Owen Sound. 131 p., 8vo. Toronto, 1891. *The Society.*

Philadelphia. Transactions of the College of Physicians. Third Series. Vol. XV. 258 p., 8vo. Philadelphia, 1893. *The College.*

Toronto. *Canadian Institute.* Transactions. Vol. IV. Part I. 222 p., 8vo. Toronto, 1894. *The Institute.*

—— *Canadian Institute.* Seventh Annual Report, Session 1893-94, being part of Appendix of the Report of the Minister of Education, Ontario. 22 p., 4to. Toronto, 1894. *The Institute.*

ACADEMIES (British).

London. *Royal Statistical Society,* Journal of. Vol. LVII., Part I. 234 p., 8vo. London, 1894. *The Society.*

—— *Royal Institution of Great Britain.* Proceedings, Vol. XIV., Part I., 1893. 168 p., 8vo. London, 1894. *The Institution.*

—— *Surveyors Institution.* Catalogue of the Forestry Collection. 23 p., 8vo. London, 1894. *The Institution.*

—— *National Footpath Preservation Society.* Sixth Annual Report, 1890-91, 48 p., 16mo. *The Society.*

Manchester and Salford Sanitary Association. Annual Report of the Committee of, and of the Committees of, its Affiliated Societies for 1893. 72 p., 8vo. Manchester, 1894. *The Association.*

Newcastle-on-Tyne. North of England Institute of Mining and Mechanical Engineers. An account of the Strata of Northumberland and Durham as proved by boring and sinkings. 360 p., 8vo. Newcastle-on-Tyne, 1894. *The Institute.*

Army Medical Department. Report for the year 1892. With Appendix. Vol. XXXIV. 425 p., 8vo. London, 1894. *The Director General.*

Board of Agriculture. Agricultural produce statistics of Gt. Britain, showing the estimated total produce and average yield per acre of the principal crops, with abstract returns for the United Kingdom, 1893. 35 p., 8vo. London, 1894. *The Board.*

Corfield, *Prof. W. H.* Dwelling Houses, their Sanitary Construction and arrangements. 125 p., 8vo. London, 1894. *H. K. Lewis.*

Cholera Hospitals (Ireland) Act, 1893. 3 p., 4to. London, 1893. *Purchased.*

Crimp, *W. Santo.* Sewage Disposal Works. A Guide to the construction of works for the prevention of the pollution by sewage of rivers and estuaries. 349 p., 8vo. London, 1894. *The Author.*

Collins, *H. H.* Some of the Principles of Sanitary Building. 20 p., 16mo. Reprint from the "Architect and Contract Reporter." *The Author.*

Dukes, *Dr. Clement.* On the features which distinguish Epidemic Roseola from Measles and from Scarlet Fever. 39 p., 8vo. London, 1894. *The Author.*

Greenwell, *Allan.* Steam Road Rolling. 7 p., 8vo. London, 1894. *The Author.*

Hippeau, *Paul.* Une Visite à l'Hôpital International. 76 p., f.cap. Paris, 1893.

Henderson, *A.* Modern Drainage—Principle and Practice. 24 p., 8vo. Sydney, 1894. *The Author.*

Isolation Hospitals Act, 1893. 8 p., 4to. London, 1893. *Purchased.*

Jones, *Charles.* Refuse Destructors, results up to the present time. 73 p. Plates. 8vo. London, 1894. *The Author.*

Japan. The Annual Report of the Health of the Imperial Navy for the 25th year of Meije (1892). 65 p., 8vo. Tōkyo, 1893. *Central Sanitary Bureau, Navy Department.*

Local Government Act, 1894. 71 p., 4to. London, 1894. *Purchased.*

Local Government Board. Mr. Evan Evans' Report on an outbreak of Diptheria at Rainham, in the Romford Rural Sanitary District, Essex. 7 p., f.cap. London, 1894. *Dr. Thorne Thorne.*

——— Dr. Bruce Low's Report on an outbreak of Enteric Fever in the Urban Sanitary District of Shildon and East Thickley, in the County of Durham. 21 p., f.cap. London, 1894. *Dr. Thorne Thorne.*

——— Dr. S. W. Wheaton's Report on an Outbreak of Diphtheria in the Hinckley Urban and Rural Sanitary Districts. 18 p., 8vo. London, 1894. *Dr. Thorne Thorne.*

——— Orders *Re* Bakehouses. 1 p., f.cap. London, 1894. *The Board.*

MEDICAL OFFICERS' AND OTHER REPORTS.

Batley, 1891, 1892, 1893.	*J. Lindley.*
Blackpool, 1893.	*Dr. A. J. Anderson.*
Bridlington, Urban, 1893.	*W. A. Wetwam.*
„ **Rural**, „	*W. A. Wetwam.*
Brighton, 1893.	*Dr. A. Newsholme.*
Chelsea, 1893.	*Dr. Louis Parkes.*
Cromer, 1893.	*S. T. Taylor.*
Erpingham, 1893.	*S. T. Taylor.*
Lanark, 1893.	*Alex. Hay.*
Maidstone, 1893.	*W. Jackling.*
Merthyr Tydfil, 1893.	*T. J. Dyke.*
New Windsor, 1893.	*Dr. E. Casey.*
Roxburgh, 1893.	*A. Morris.*
Southampton, 1893.	*Dr. A. W. Harris.*
St. Faith's Union, 1893.	*S. T. Taylor.*
St. Helens, 1893.	*N. McNicoll.*
St. Pancras, for March. 1894.	*Dr. J. F. J. Sykes.*
Toxteth Park Local Board, 1893.	*J. Price.*
Wigan, 1893.	*John Summer.*

Metropolitan Water Supply. Royal Commission on. Maps, plans, and diagrams to accompany the Report of the Royal Commission. f.cap., London, 1893. *Purchased.*

Metropolitan Asylums Board. Reports for the year, 1893. 292 p., 8vo. London, 1894. *The Board.*

New Jersey. Seventeenth Annual Report of the State Board of Health, and Report of the Bureau of Vital Statistics. 612 p., 8vo. Trenton, N. J., 1894. *The Board.*

Newman, *R. W.* The Sanitary Engineering of Dwellings. 18 p., 8vo. Excerpt from Transactions of the Junior Engineering Society. *The Author.*

New South Wales. Report of the Department of Public Works for the year 1892. 161 p., 8vo., Sydney, 1893. *The Agent General.*

Ottawa. *Inland Revenue Department, Laboratory of.* Bulletin, No. 35, Vinegar. 19 p., 8vo. Bulletin, No. 36, Fertilizers as sold. 17 p.. 8vo. *The Department.*

Public Health (London) Act, 1891, Amendment Act, 1893. 2 p., 4to. London, 1893. *Purchased.*

Patent Office. *Abridgments of Specifications.* Period, 1877—1883.
—— Relating to Electricity and Magnetism. Electrodisposition and Electrolysis
—— Electric Motive Power Engines and Similar Apparatus.
—— Metals, Cutting and Working.
H. M. Patent Office.

Péclet, *E.* Traité de la Chaelur Considérée dans ses Applications. Vols. I. II. III. 476 p., Paris, 1860; 500 p., Paris, 1860; 484 p., 8vo. Paris, 1861. *Edward Robins.*

Piton, *Dr. Alain.* Report of Experiments relating to Electrolysed Sea-Water prepared by the Hermite System. 39 p., 8vo. Brest, 1894. *Paterson and Cooper.*

Rafter, *G. W. and* **Baker,** *M. N.* Sewage Disposal in the United States. 598 p., 8vo. New York, 1894. *D. Van Nostrand Co.*

Registrar-General (England). Fifty-Fifth Annual Report of Births, Deaths, and Marriages in England. 230 p., 8vo. London, 1894. *The Registrar-General.*

Rivers Pollution Prevention Act, 1893. 1 p., 4to. London, 1893. *Purchased.*

Rome. Circa' i fatti principali riguardanti l'igiene e la sanità pubblica nel regno nel secondo semestre dell' anno 1893. Epidemia colerica all' estero e nel regno. 63 p., f.cap. Roma, 1894. *Ministero dell' Interno.*

St. Pancras. Annual Report from the Chairman of the Health Committee on the Business of the Department. 27 p., 8vo. London, 1894. *Dr. J. F. J. Sykes.*

Truman, *M. and* **Sykes,** *E.* Nursing Old Age. 146 p., 8vo. London, 1894. *The Authors.*

Williams, *Robert, A.R.I.B.A.* More Light and Air for Londoners. 53 p., 4to. London, 1894. *The Author.*

Wallis, *I. White.* Manual of Hygiene. 150 p., f.cap. London, 1894. *The Author.*

KENNY & CO., PRINTERS, 25, CAMDEN ROAD, LONDON, N.W.

Volume XV.—Part III.] [October, 1894.

JOURNAL
OF
THE SANITARY INSTITUTE.

CONGRESS AT LIVERPOOL

INAUGURAL ADDRESS TO THE CONGRESS,

BY SIR FRANCIS SHARP POWELL, BART., M.P.
(FELLOW.)

Delivered September 24th, 1894.

FORTUNATELY for myself, even more fortunately for those before whom it is my privilege to appear, my address is one of an inaugural character, dealing in a comprehensive and general manner with the work of sanitary progress, and not endeavouring to enter into the technical details which will hereafter be discussed by highly accomplished masters of the subjects which will be submitted to the consideration of the congress. Leaving to scientific men the exposition of science, I shall restrict myself within the boundaries, which are ample and wide, of public health as affected in England and Wales by administration and by law.

I must, however, in the first instance congratulate the Congress, and do so the more warmly because a Lancashire man myself, on the meeting of this Institute at Liverpool, and in the Halls of this University College, one of those brilliant and characteristic achievements of modern civilization, which have brought ancient university culture, instinct with new life, to the great seats of our industrial and commercial activities. Here, as is known to all, is the maritime centre to which men of every nation resort, bringing difficulties as well as strength, anxious problems as well as opportunities for solving them, great wealth but at the same time a perplexing proportion of poverty and disease. Here the authorities in their encounter with evils of no ordinary magnitude have obtained exceptional powers, which they exercise with unfailing vigour. Here, the water supply of the district having failed, the Corporation have laid under tribute the hills of Lancashire and the distant valleys which lie secluded amid the mountains of Wales. Here, if anywhere, our deliberations will bring light into dark places, disentangle many complications, make smooth paths now rough and overgrown with obstacles hitherto deemed impracticable.

It is impossible to survey the field without a sense of satisfaction, almost of triumph. The difficulties which hinder our progress diminish both in area and in gravity. The necessity for devoted attention to conditions favourable to health is felt year by year both more widely and more keenly. No man has the false courage to deny this necessity: few men are unwilling to take some share in our labours or in the cost incurred by the adoption of our policy. There may be reluctance in some districts where the community has outgrown the proportions of a village, but has not attained the dimensions of a town. This intermediate state has been the cause of the greatest anxiety during the whole course of sanitary administration. It is in these communities that hesitation still lingers. It is to them that our persuasive energies must be directed. In large societies the urgency is felt, the machinery is ready at hand, public opinion is more active, the resources are abundant.

Improvement in public health has justified both the cost and the labour expended. Some estimate of the expenditure of capital and the readiness to expend it may be formed from the fact that the Local Government Board has during the last twenty years sanctioned a capital expenditure, chiefly for sanitary purposes, of £53,021,334 in urban, and of £3,923,270 in rural districts, while, during the same period, local acts have authorised a further expenditure of £67,335,956. Power to raise other loans for similar purposes has been conceded to other bodies, and to Commissioners holding power for special objects connected with the sanitary progress of the people. Vital statistics abundantly prove the wisdom of such expenditure. With these facts before us we must press forward, jealously maintaining the ground which we have secured and extending the boundaries of our dominion.

This Institute may justly claim some part in this work. By meetings, by lectures, by literature, by examinations, we have at once spread knowledge and tested the accuracy of the information obtained by our students. While recognising with gratitude valuable assistance and support from others able to give both, we must tender one word of respectful acknowledgment to Her Royal Highness the Duchess of Albany, who having on many occasions honoured our Lectures by her presence and eminently sympathetic attention, graciously distributed the Prizes to the ladies who proved by examination that they had not attended the Lectures in vain.

I now venture to refer to some subjects which appear worthy of consideration at this stage in our history.

No address delivered to a Sanitary Congress at Liverpool during the present year would be in any sense worthy of the occasion without mention of quarantine. Considerations, partly political, partly arising from the slow adoption of new ideas, have caused delays which it is more easy to regret than to condemn as unusual or unprecedented. So long since as 1865 Sir John Simon, in his report lately reprinted, pointed out that the "conditions which would have to be fulfilled for an effectual quarantine are conditions of national seclusion, and the fulfilment of such conditions by England would involve fundamental changes in the most established habits of the country." Lord Norton's Sanitary Commission of 1870 incidentally considered this subject, and it is now no breach of confidence to say that some members of that Commission regarded the continuance of powers for the purposes of quarantine rather as a means of preventing vexatious regulations by other powers than as a reliable protection to ourselves. Dr. Thorne Thorne in his report of this year illustrates the effect of putting all passengers on ships from infected ports into quarantine for five days by stating that in November, 1892, Calais being then an infected port, 10,804 passengers, excluding the crews, would have had to be detained in quarantine at Dover, the number, under detention at any one time, ranging from 1019 to 1723. Like incidents would have occurred at other ports on the Channel; the result, as Dr. Thorne remarks, "would have been one which could only have brought ridicule on our sanitary administration." Such regulations must fail. Well wrote Sir J. Simon, with his quaint humour, in the report above mentioned, "Where great commercial countries are concerned, it can scarcely be dreamt of that quarantine restrictions will be any thing better than elaborate illustrations of leakiness." The necessities of growing commercial intercourse and the progress of scientific opinion drew increasing attention to this subject. Successive conferences, some between physicians and experts, some of a political character, fully discussed this problem. At length, in the year 1892, international sanitary conventions, dealing chiefly with traffic through the Suez Canal, were held at Venice and Paris. Then came the lessons of the cholera epidemic on the Continent in 1892. No test could be more severe, no success more complete. Without quarantine, by means only of strict execution of carefully devised regulations our country was protected from the epidemic. Although thirty-five cases of cholera, eleven of which terminated fatally, reached our shores between August 25th and October 18th, of 1892, the disease in no case extended to any person beyond those who had arrived from abroad. Much credit is due both to the Local Government Board and to the local authorities for their energetic and eminently successful action. They had in their hands, and did not fail to use, a powerful weapon in the Act for the notification of infectious disease; which then, as always, greatly assisted medical supervision. Finally, the Dresden Convention, ratified in 1894, concluded the series. This convention widely extends the liberal International Preventive Measures, applicable both to passengers and to merchandise. Subject to certain international conditions and to exceptions relating to "susceptible goods," merchandise may no longer be detained in quarantine on a land frontier or arriving by sea. A ship arriving from an infected port is regarded as a healthy ship, and even from suspected and infected ships the sick are to be immediately disembarked, healthy persons being liable to observation during a period not exceeding five days. In the United Kingdom healthy persons from such ships are subject only to medical supervision in their own homes.

The abandonment of quarantine establishments in this country was a necessary consequence of these events. It will always continue a cause of satisfaction to your President that he pressed the subject on the attention of the Government in the course of last session, and received an assurance that such amendments of the law as have been found necessary will be introduced next session; when quarantine establishments will for ever disappear from these islands.

Among the Powers taking part in these conventions the Prince of Montenegro alone preserves for his dominions this blessed inheritance of quarantine.

But if public opinion has moved surely, though without impatience, as regards quarantine, the like favourable description does not apply to the method of considering and dealing with vaccination. Having regard to the present condition of this question few delays can cause more surprise and disappointment than those which attend the proceeedings of the Royal Commission on Vaccination. While those whose professional studies justify the full expression of a firm opinion are unanimous in one direction, there is hesitation and doubt among many whose action it would be unjust to censure as perverse, however deplorable we may deem their conduct. It is a consolation to find the activity which arises when an epidemic appears. This circumstance goes far to prove that the omission of vaccination results rather from want of decision and steadfast resolution than from hostility or real heartfelt doubt. Let us hope that some epidemic so severe and so sudden as to leave no time for protection may not remove all doubts and confirm at the sacrifice of precious lives the wisdom of those who have devoted laborious years to rigid investigations and to learning the lessons of experience. We cannot believe that the time will never come when the explosive matter now so widely scattered from neglect of vaccination will not give terrible evidence of its fatal power. Meanwhile it is surely the part of true wisdom to follow the judgment of those best entitled to give judgment, and to listen, while there is yet opportunity, to the evidence which is so clear and so certain to those willing to see and hear, that in vaccination duly performed we have a security against one of the most grievous maladies which can afflict mankind. Never was there a time when words of caution were more necessary. The percentage of cases not finally accounted for as regards vaccination was higher in the year 1891 than in any former year since the commencement of the Vaccination Act. In certain Unions 75 or even 84 per cent. of children whose births were registered then remained without the security of vaccination. It may reassure some who are in doubt to be informed that increased precautions are being taken by the authorities to secure that vaccination be at once efficient and safe.

Treatment of disease lies beyond the scope of this address. But those who have care for the vast and most exemplary population which derive its livelihood from the textile manufacturers of Lancashire and Yorkshire will pardon my reminding them that phthisis is now regarded as a disease which is disseminated and to a considerable extent under control provided that measures are adopted in time. Few diseases cause more sorrow than consumption. None creates more heartfelt sympathy. Suffice it to express a hope that this discovery may not remain dead, but will lead to the adoption of such measures as may at least check the ravages of this now wide-spread malady. The well-ventilated mill, the healthy dwelling, abundant exercise in fresh air are increasingly at the command of all, and if other precautions are taken, will doubtless in due course confirm the scientific opinion which I have endeavoured to enunciate.

Those who observe public health in a wide acceptation of the term, watch with increasing interest the progress or diminution of Insanity. The last Report of the Lunacy Commissioners and the Census of 1891, give ground for the hope that insanity is not on the increase. The rate of admission in private asylums has remained constant since 1885, that in pauper asylums having increased from 4·14 per 10,000 in 1885 to 5·28 in 1893. This latter increase is regarded by the Lunacy Commissioners as proof only that larger numbers of the insane are yearly brought within official cognizance. They retain the opinion that there is no proportional increase of insanity, or at all events none material, in this country. The rate of discharge must be taken into view while dealing with these figures. There is said to be a change of feeling among the relatives of pauper patients which causes a diminution in the rate of discharge, and keeps up a proportion which would otherwise diminish. This change proves that the afflicted are well cared for, and that there is general confidence in the treatment received by the unhappy inmates.

One cause of disease cannot be excluded from consideration. The enquiry, as yet incomplete, of a Committee of the House of Commons on the adulteration of food is evidence of a strong opinion that fraud and consequent danger to health is still practised. But here, as elsewhere, the administration of the Law, not the Law, may be at fault. There are forty-five districts with a population of 3,000,000, in which the Adulteration of Food Acts are either wholly in abeyance or are so imperfectly administered that they may fairly be described as in disuse. Although heavy but inadequate fines have been in some cases inflicted, undue leniency often deprives purchasers of the protection to which the Statute entitles them. This mistaken policy continues, notwithstanding the fact that the proportion of adulterated samples shows a tendency to increase. There is reason to fear that fevers are still caused by careless or even criminal practices in the preparation or distribution of milk, especially in London, where the proportion of adulterated samples in the year 1893 was no less than one quarter of those taken.

Among articles wherein adulteration extensively prevails may be named butter, mustard, lard, aerated waters, cocoa, and vinegar, all of which are largely consumed by the working class. The temperance advocate will rejoice to learn that of 363 samples of beer only 10 were adulterated in 1893, and of 782 samples of spirits less than twenty per cent. were adulterated, water being the adulterating substance in nearly every case. A distinguished medical officer in Liverpool points out that adulteration of egg-powder sold as a "complete substitute for eggs" has caused much disease among young children. The above examples show the dangers to health which surrounds us, and necessitates ceaseless vigilance. Authorities ought surely to be more on the watch in a matter so gravely affecting public health, especially in the case of children.

Passing from this more special enumeration, I must remind the Congress that public health must ever largely depend in great measures on the condition of the house. Rich and poor, urban and rural populations alike, have paid and still pay heavy penalties for errors and neglects. Knowing the course of legislation since the introduction of the Sanitary Act in 1866, I venture to assert with confidence that the duties of the Legislature have been amply fulfilled. Defects and mistakes in the statutes may be pointed out; but speaking with all due reserve it may be once more stated, without fear of disproof, that ad ministration rather than legislation now demand the energies of the sanitary reformer. Localities, doubtless, have their own special wants; but even those are to a great extent met by the adoptive acts recently passed. Exceptional cases will from time to time require private bill legislation; but even here precedents, almost equivalent to a code, appear now to govern, rightly or wrongly, the proceedings of the Committee of the House of Commons to which such bills are referred. The two London statutes of 1891 and 1894 following similar enactments for the provinces, and some minor enactments, supply for the time, at least, the wants of the metropolis. The reader of the latter statute will learn with disappointment that domestic buildings in London may still be erected to the height of eighty feet, exclusive of two storeys in the roof, power being unfortunately reserved to the London County Council to sanction the construction of buildings even of more gigantic proportions. Air and light cannot perform their life-giving functions at the base of these structures, still less within courts enclosed therein. The lighting and ventilation of such courts is left by the new statute in a less favourable condition than that prescribed by a recent statute for the courts in Glasgow; and the rules as to height of rooms are less satisfactory than those which exist in many provincial towns, or those which are voluntarily adopted by the Peabody trustees. It is not an exaggeration to say that the dwellings of our nation are being built in the course of the present half century. The erection of new houses and the destruction of old are everywhere seen. They are erected under bye-laws for the most part wise, and are maintained under regulations conducive to health. Errors of judgment hinder progress. The erection of back to back houses, for example, should never be permitted in new streets. Too great haste may defeat excellent intentions. Doubts are already expressed as to the system of huge constructions under the name of Artizans or Model dwellings. The Mansion House Council, no mean authority, describes certain blocks of artizan's dwellings as a "difficulty which wants promptly dealing with." "These (say their Committee) have been erected without any regard to sufficient air and light around them." They add, let us hope with pardonable impatience rather than mathematical accuracy, that "these places are haunts of dirt and immorality."

Be it also remembered that in re-building on sites which have been occupied perhaps during many generations by houses in an insanitary condition it will not suffice to clear the ground. The site itself is too often polluted, and must be thoroughly purified by the removal of all noxious matter and by other effective measures.

But the most perfect structure must fail when under the control of unworthy tenants. Truth compels those who deal with this subject to confess that widespread neglect or even wilful destruction disgraces the condition of many cottages. The most complete discharge of duty by an owner is of no effect unless the occupant protects and cleanses the property committed to his charge.

Public authorities are helpless without the sanction of public opinion. Such opinion must be created by active agencies, by suasion, by personal visits, not of busy-bodies, who open more sores than they heal, but by self-denying, persistent, wise, and sympathetic visitation. No paid official can wait and persuade as can the kindly visitor. No summons or order can accomplish what may be done by such intervention. The story of the Manchester and Salford Sanitary Association and of the Mansion House Council is the same. Manchester and Salford are London in this matter, London is Manchester and Salford. Evils beyond the power of description have existed; by slow steps they are diminished or even disappear when encountered by such ministrations. No work was ever more sure of good result. But there must be no relaxation; there must be a ceaseless struggle against the downward current, else we shall float down the stream and lose all the advance so laboriously gained.

In this progress, as elsewhere, we must place confidence in our schools. It is difficult to believe that children who pass long and pleasant hours in cleanly and well-ventilated schools will rest content with dirty and unwholesome dwellings. These little missionaries may prove our best allies, and by their gentle admonitions and nimble hands aid in effecting those improvements which will so greatly conduce to their well-being, both in childhood and in later life.

The factory and workshop not less than the dwelling is comprehended within the wide range of our sanitary province.

For them each political party shows equal care. The present Home Secretary executes with sympathy and full appreciation the statute passed by his predecessor. The employment, within wise limits, of Female Inspectors, especially as regards workrooms, will reveal many secrets and effect long called for reforms. Increased security against accident, improved appliances for ventilation (none be it noted of avail without intelligent co-operation of the workpeople), and general conditions creating greater physical comfort during the hours of labour will increasingly improve the health of the artizan population. Much room remains for such improvement, but he must be a careless observer of the scenes around him who does not observe with gratitude the happy influence of these reforms throughout Lancashire and Yorkshire. Health alone for the moment occupies our thoughts, but it cannot be forgotten that the moral tone of the factory and workroom hands and their mode of life exert influences upon their health not less important than the conditions within the control of public authorities and of Parliament.

It will not suffice to guard the workshop and the dwellings from injurious influences within. The health of the people cannot be sound if the air be polluted. We must doubtless make sacrifices in order to conduct industrial processes. But the magnitude of those sacrifices must be diminished. We know the common saying in reply to a complaint of nuisance arising from smoke, that "Smoke brings money." There is a new and better adage "Smoke brings cost." While more regard for the well-being of the neighbourhood may lessen the nuisance, economy of fuel arising from artificial scarcity may compel the adoption of arrangements which will lessen the discharge of smoke into the atmosphere, both from factories and from private dwellings. The working classes, now everywhere endeavouring to raise their condition, may discover that the smoke which renders cleanliness difficult and the brightness of a home impossible, imposes upon them labour which is unnecessary and cost which may well be spared.

The advance of chemical knowledge and mechanical skill year by year brings under control gases and other residual products hitherto destructive both to health and comfort. The fumes of Widnes have in other days at any rate made themselves felt in the neighbourhood of Liverpool. The new Act of 1892, widely extending the number of distinct processes brought under the Alkali Acts, has come into effective operation. There are now 1,495 processes of manufacture under inspection as against 1225 in 1892, or an increase of 270. And this legislation is not in vain; of acid from chemical manure works 94·5 per cent. is arrested in its way to the atmosphere, sulphate of ammonia, formerly most offensive, is now manufactured even in fashionable watering places, without the knowledge or suspicion of those frequenting the health resort. And the value of the commodity, in other words the saving, by the conversion rather than the rejection of the substance is estimated at £2,000,000 per annum.

In lead deposit works, arsenic works, tar works, processes are now being carried on which greatly diminish, and may ultimately remove, mischief which has been too long endured. Even shoddy claims attention, and as chemical knowledge among those responsible extends, acid gas employed in the operation will no longer pass into the air to the great injury of machinery in neighbouring mills. The Chief Inspector in March of the present year remarks with perfect accuracy, "The vista before our inspectors is ever open, their goal recedes, for the act enjoins that the best practicable means shall be employed for preventing the escape of noxious vapours. Duty, therefore, advances with knowledge. There is much ground, however, for congratulation as to what has already been done."

An exception must be made to the statement that improved administration rather than amendment of statutes has for the present the first claim. There is one necessity which presses with such urgency and force as to demand the most prompt and effective action. Long years have passed since the Royal Commission on River Pollution issued their report. Meanwhile the defects of the River Pollution Act have become matters of common knowledge. We cannot hope by one effort in one generation to restore our streams to their original purity. But we can do much. The industrial system of this country has, relatively to the age of our civilisation, continued during but a few years. Those years have been a period of rapid, but not always well considered or comprehensive extension. The grandfathers of men now active among us were the founders of our manufactures. Let those, who with infinitely greater advantages gather the fruits of their toils, remove the evils which have been created during years of immaturity and of haste. The effort is worthy of such labourers as we summon to the task.

Here as elsewhere Local Legislation has led the way. In the year 1892 the Manchester Ship Canal, soon to be supplied with waters from the Irwell, threatened pestilence to widely populated districts. The Mersey and Irwell Rivers Pollution Prevention Bill became law. It is no fault of the joint committee, which is the executive authority under that Act, that Her Majesty when opening the canal was prevented by the condition of its waters from passing more than a few yards along the channel. But this incident, the recurrence of which, the energies of that efficient committee will render impossible, is ample demonstration of the magnitude of the mischief. Where the sovereign was advised not to pass, a large community of her people dwell. What Lancashire and Cheshire has accomplished, the West Riding of Yorkshire, experiencing similar, but not equal, difficulties, has sought to effect. The West Riding Conservancy Act of 1894, following a Provisional Order Act of a former year will bring under control rivers and streams which are now dangerous to public health and a disgrace to our manufactures. Some details of administration in the Bill as finally passed are in my judgment less effective than corresponding details in the Mersey and Irwell Act. But the modifications may remove friction and may thus. although less satisfactory in form, prove not less effective in administration. They may also assist the County Councils' Association when considering the new print of the River Pollution Bill, which will be introduced in the next Session. The Bill has been twice submitted to the House of Commons, but its further progress was prevented by the unfortunate condition of our proceedings, which permits any one member by one scarcely articulate expression to prevent the most valuable legislation. I am not without hope that Government will grant an inquiry by a Select Committee. Those who feel difficulties would thus have every opportunity of stating them, and Parliament would be better prepared to decide as to the concessions which ought to be made to the exigences of manufactures and the susceptibilities of some municipal authorities. The Government of the day may then undertake a task which appears for the moment, and in the present condition of our procedure, to exceed the opportunities of non-official members.

The Thames Conservancy Act of 1894 is another step in advance. One strange concession to a Steam Navigation Company supported, as we may assume, by sufficient evidence is, to my thinking, a blemish to the Act; but as a whole the Legislation respecting the Thames is worthy of the occasion. Sewage or any other offensive or injurious matter is not to pass into the Thames or any tributary through any sewer, pipe, or channel not at the passing of the Act lawfully used for that purpose. Even in such cases the Conservancy are directed to give notice to the person causing or suffering the flow or passage of such offensive matter, to discontinue the same within three months, power being given to extend the term to meet exceptional cases. An appeal is given to the Board of Trade, which is without any officers trained to decide such a question, instead of to the Local Government Board, which commands the willing services of a highly qualified scientific staff. Such eccentricities of Legislation are, however, but too familiar to us, and though deeply to be regretted, are condoned by those who know the difficulties of effecting any reasonable reform by Private Bill, or indeed by any other method of Legislation.

In the above remarks I have entered upon no descriptive details. They are but too well known. Would that any words from me as occupant of this Presidential chair could induce men in responsible positions to give us, in these our efforts, the weight of their high authority and their great influence. To any lover of his kind it is melancholy to dwell on the scenes presented on many river banks and in the streams themselves. We desire the advance of our people in health, in culture, in sense of beauty. Such advance is impossible when they live amid such surroundings. Let reform be made quickly and effectively. The time for reform has come. Any unnecessary delay in a question of such moment cannot justly escape censure or even severe condemnation.

Consideration of the field already occupied by general and local legislation cannot be complete with regard to the extent to which the most important adoptive acts are in operation.

The Infectious Disease Notification Act had in March, 1894, been adopted in 761 urban districts and 473 rural districts, including with London, where the act came into force without adoption, and forty-nine towns having notification under local acts, a population of 26,401,826 out of a total population in England and Wales according to the last census of 29,002,525. There are also thirty-seven port districts where the act is in force. The Infectious Disease (Prevention) Act of 1890 was on the same date wholly or partially in force for the population 13,284,711 by voluntary adoption, including 463 urban and 185 rural authorities; and in London without adoption for an additional 3,875,286. On the same date 620 urban sanitary authorities had adopted the whole or particular parts of the Public Health Amendment Act, 1890. 184 rural authorities had also adopted the act, so far as the same is applicable to their districts. The great majority of our population is, therefore, subject to the provisions of this act.

There is, without question, ample opportunity for valuable discussion with a view to possible amendment in the law on what may be described as collateral subjects, not ordinarily included within the category of laws affecting public health. Among such may be mentioned laws relating to medical assistance to mothers during the season of their greatest need, the regulations governing the registration of deaths, including the causes of death, and the burial of the dead, the case of still-births being dealt with in both cases. There are the pauper children respecting whom we desire to know whether their health and training would be more efficiently provided for by boarders-out than by the present system. The occupants of common lodging houses, the humblest of our population, require further protection during their sojourn in such dwellings. Much remains to be done before our slaughter-houses and arrangements connected therewith are wholly satisfactory. Although the increasing wants of London have been in some degree met by the East London Water Act of last Session, the exhaustive Report of the Royal Commission on the Metropolitan Water Supply claims the fullest consideration from those who have responsibilities within the Metropolitan area. This necessity arises not only from difficulties connected with supply of water, but also from the mischief caused by the diminished flow in the Thames.

The new Act for the Prevention of Cruelty to Children relieves much anxiety and justifies the expectation that the provisions of the law suffice for their benevolent purpose. Risk to health from infections has been greatly diminished by Lord Thring's Act of 1892 providing for the universal establishment of hospitals for the isolation of such cases.

The last words of these imperfect observations, necessarily written during a short holiday on the Continent with but few books at hand, must invite attention to coming days.

"To the pure all things are pure," says the moralist. The sanitary reformer, in a country of representative institutions, gives practical application to the proverb by inviting men who are themselves pure to make all things pure. Let us wait no longer for new laws, but put into effect the laws already on the Statute Book. There may be some return of population to rural districts, but a vast proportion of our inhabitants must continue, and probably in growing proportions, to dwell in urban districts. This tendency appears to prevail throughout all civilized countries. A German writer cited by the Reporter for the Labour Commission remarks that "It is a phenomenon of annual recurrence that the harvest cannot be got in at the right time. In some districts the supply of labour is insufficient even in the winter. The physical and moral health of our nation, as well as its military strength, suffer the most grievous injury from over-rapid pressing into city and factory life and from trans-oceanic emigration." We must therefore with all zeal bestow energy and knowledge on the improvement of our towns. To the attractions already dominant let there be added those of health and even of ornament. Already the records of death prove that the proportion of deaths in many towns does not differ as widely as of old from the proportion in rural districts. Let that difference lessen to the vanishing point. Towns have at their command efficient drainage, ample supply of water, prompt removal of refuse. They are acquiring by slow but sure degrees arrangements of their dwellings favourable to health. To the spacious parks, so civilizing in their effects, must be added the open spaces protected from all cause of annoyance, where the toiler may seek repose near his dwelling among pleasant surroundings during the intervals of his labour. Lord Meath's Public Garden Association can now claim between one and two thousand acres of open spaces as the result of their efforts within the Metropolis. What has been done in London must be possible elsewhere.

The baths and washhouses, no longer so far removed from the dwelling as to be of little avail to the workman in his comparatively distant home, will throw out branch establishments for himself and his family within reach of his dwelling. The gas engine and the mysterious agency of electricity giving motion, heat and light, will remove many debilitating and uncivilising influences. The desire for a higher life, now so salutary, acting through an intelligent public opinion, will accomplish these beneficial reforms; and our towns, retaining all their colossal grandeur and their power, will be the scenes of ever-increasing refinement.

I know well, no man can know better than myself, the disappointments, the mortifications, the fatal illustrations of the weaknesses incident to our nature, which will impede our course ; but the duty remains the same. Progress, already made, gives confidence for the future. I, speaking for myself, am full of hopes. Those hopes will be in a large measure fulfilled if the advance of the next half century is equal to that made in the fifty years now counted among the past. I see on every side reasons for encouragement, none for holding back. There is everywhere fuller knowledge, riper experience, more sympathy from public opinion. Let us all press on in our great task, each a thoughtful and active worker in his own province. Our reward will be seen in every home which we purify, every family which we strengthen, every population which we elevate. None can foresee what struggles are at hand, what rude encounters are near, what severe competitions are to be met. It is our endeavour and our duty to prepare our nation for every trial, to give strength to bear hardship, vigour to conduct the contest, endurance to persist until the victory is gained.

SECTION I.

SANITARY SCIENCE & PREVENTIVE MEDICINE.

ADDRESS,

By E. KLEIN, M.D., F.R.S.,

PRESIDENT OF THE SECTION.

THE ETIOLOGY OF TYPHOID FEVER.

Before I enter upon the subject which I have chosen for this address, I wish to offer my thanks to the Council of the Sanitary Institute for the honour they have conferred upon me, by their invitation to preside over this section. The subject on which I propose to offer some remarks, and for which I must ask your indulgence, is the Etiology of Typhoid Fever.

There are several reasons which guided me in the choice of this subject. In the first place, there can be no fitter occasion than the present one for the discussion of such a subject. This Congress, embracing every department of Sanitary Science, is constituted of workers who are constantly called upon to pay attention to this wide-spread and, in places, endemic infectious disease. Be they Medical Officers of Health or Sanitary Inspectors, be they engaged in any of the numerous branches of sanitary engineering, they are frequently called upon to devise means against the spread, and for the prevention of this dire malady.

In the second place, I have for some years been engaged in a close study of the Pathology and Bacteriology of this disease, and, therefore, am able to make a few observations thereon. It is admitted that typhoid or enteric fever possesses as well marked clinical and pathological characters as any communicable disease. Since the writings of Budd and Simon on the subject of the mode of spread and prevention of typhoid fever, it has become an axiom in sanitary science, and has in several well-known instances received direct and conspicuous confirmation, namely: That typhoid or enteric fever is a well-defined communicable disease, spreading by specific contagium.

Rodet, G. Roux, Vallet, and Arloing,* Kellog† and others, have put forward the view that the bacillus known as the Eberth-Gaffky bacillus of typhoid fever, now admitted to be almost constantly present in the alimentary canal, in the mesenteric glands, and in the spleen of cases of typhoid fever, is no other than the bacillus coli communis, which is a constant and normal inhabitant of the bowels of man and animals under perfectly healthy conditions. And further they have contended that the bacillus coli passed with the normal dejecta, is capable of acquiring in sewage specific and virulent properties, so that when re-introduced by water, milk, or other articles of food, into a normal individual, it has become endowed with the power of setting up in him the specific and communicable disease, typhoid fever.

---

* Transactions of the International Congress of Hygiene, London, 1891 Section Bacteriology, Vol. II., p. 272.

† Mod. Med. and Bacter. Review, No. 2, 1894, p. 29.

In this view typhoid fever may—in so far as it is referred not to a microbe directly derived from antecedent typhoid fever or other disease, but to a saprophyte that has become altered in its physiological effect by sojourn for a while in sewage—arise so to speak *de novo.* But this contention is the outcome solely of bacteriological study, not of epidemiological observation and experience on the part of those advancing it. These authors base their views as to the origin of typhoid fever from bacillus coli, and as to the identity of the two microbes, solely on this, that they are unable to distinguish in their laboratory experiments the bacillus coli from the bacillus of typhoid fever. I propose to show you that this distinction is not at all difficult, and that the two microbes—as far as our present exact methods enable us to draw inferences—are two well characterised and different species, It must, however, be added that they belong to a family of species which have certain characters in common, though members of the family differ from one another by some well marked features.

The bacillus coli is normally copiously present in the large intestine of man and animals; in the lower part of the small intestine it is also constant, but grows here less copiously. All matters such as dust, earth, solids and fluids, and particularly sewage, which have been contaminated or been in contact with intestinal discharges of man or animals, contain the bacillus coli. Next to the proteus bacillus—which is one of the special microbes of putrid decomposition of dead albuminous matter—the bacillus coli is one of the most widely distributed organisms. When growing in proteid matter it decomposes it and forms indol. The putrefactive changes occurring in the intestines and in organic matters polluted with intestinal discharges that are associated with the formation of indol may with justice be attributed in a great extent to the growth and activity of the bacillus coli; and for these reasons it is likely that the bacillus coli, next to the proteus, is an important instrument in the decomposition of dead proteid matter. But, unlike the proteus, the bacillus coli does not produce proteolysis and does not peptonise.

In shape the bacillus coli is an oval rod rounded at its ends, measuring about 0.5 μ. to 2 μ.; comparatively few attain the length of cylindrical rods. When examined from recent cultures some examples are seen to be of active motility, this being due to the presence at one end of one, two, or rarely three flagella. In cultures on the surface of nutrient gelatine—particularly well shown in colonies growing on the surface of the gelatine—there are, amongst a great majority of short rods, some few that are distinctly cylindrical in shape, or even short threads; the latter, as a rule, are comparatively few and far between.

The characters of the growth of the bacillus coli on the surface of gelatine, in stab culture, in gelatine plate culture, in shake culture and under other conditions, have been fully illustrated in the Report of the Medical Officer of the Local Government Board, and it is not necessary to enter here into a detailed description.*

Of particular interest is the growth of bacillus coli in a gelatine shake culture, and in milk. In the former a conspicuous formation of gas bubbles takes place, which is pronounced as early as after twenty-four to thirty-six hours' incubation at 20° C.; in the latter a total curdling of the milk occurs in one, two or more days when incubated at 37° C. A curious and constant character is observed of bacillus coli when it grows in twenty-five per cent. nutrient gelatine, for, while it is growing rapidly therein at 37° C, and forming a characteristic pellicle on the surface in two to three days, the gelatine, which of course becomes fluid at that temperature, remains perfectly limpid, except for a precipitate at the bottom of the fluid.

In broth at 37° C. copious growth takes places, the broth becoming strongly turbid with the formation in two or three days of a pellicle, which later still becomes very pronounced. Such broth, on the addition of nitrites and nitric or sulphuric acid, gives a characteristic rose-pink colour, due to the presence of indol. The above characters are constantly met with in cultures of the bacillus coli taken from the intestine.

To sum up:—(*a*) Short oval rods in the majority, only relatively few long forms; (*b*) Relatively few actively motile; (*c*) Rapid growth on gelatine, in the shape of translucent filmy patches, irregular in outline, thin in the marginal, thick in the central part but without liquefaction of the gelatine; (*d*) Copious and rapid formation of gas bubbles in gelatine shake culture; (*e*) More or less rapid curdling of milk at 37° C.; (*f*) Pronounced indol reaction in broth after several days' growth at 37° C.; (*g*) Twenty-five per cent. gelatine remains limpid for several days with the formation of distinct pellicle.

---

* For detailed description and illustrations, see the Report of the Medical Officer of the Local Government Board for 1892—1893, p. 345. Plates I.–VII.

These characters are possessed by the bacillus coli taken direct from the normal intestine, and persist with constancy through however many generations this bacillus is grown in sub-cultures. They persist, too, if bacillus coli is kept in water, and they are invariable attributes of the bacillus coli in sewage, however long it be kept therein. Bacillus coli present in water polluted with normal intestinal discharges is by the above characters easily recognized, and I have not failed to so identify it, if present in such polluted waters.*

Now, contrast with this the bacillus of Eberth-Gaffky, or the typhoid bacillus. This bacillus is present in the contents of the alimentary canal, and in the evacuations of persons affected with typhoid fever.† There is no difficulty in demonstrating its presence by cultivation in the bowel discharges of a typhoid patient, and by separating it from the bacillus coli which has been mentioned as a constant inhabitant of the intestine in health and in disease. I repeat, there exists no difficulty in separating the two species by means of the culture test, as for instance in a gelatine plate made originally with typhoid dejecta, and this fact alone proves, to my mind, that the two microbes are distinct and separate from one another.

The points I would here insist on are:—That on the one hand from the normal dejecta, or from the contents of the normal intestine, the bacillus coli is the microbe readily isolable, whereas, on the other hand, from the typhoid dejecta, and the contents of the ileum of a typhoid case during the first four weeks' illness, not only is the bacillus coli isolable, but another species, namely: the bacillus of typhoid fever is, in addition, readily demonstrable by cultures. During the last three years I have had an opportunity of examining the mesenteric glands and the spleen of a considerable number of patients that died in the course of typhoid fever between the 12th and the 28th day, and I have never failed to obtain by microscopic examination, and better still by culture, the bacillus of typhoid fever in considerable numbers. The spleen particularly contained this microbe in very large numbers, and on cultivation yielded crowds of colonies of this bacillus in pure cultivation.

---

* Although the term "bacillus coli" does not cover one single botanical species, but is applicable to several varieties, differing slightly in their morphological characters and in their gowth on the surface of gelatine, nevertheless it can be stated from a wide experience that the characters mentioned above, sub. (*d*), (*e*), (*f*), (namely: formation of gas bubbles in gelatine shake culture, the power to curdle milk, and the production of indol in broth) are attributes of all the varieties of bacillus coli that can be isolated from the intestinal discharges of man and animals.

† It is quite unintelligible how Sanarelli (Annales de l'Institut Pasteur, 1894), can support the statement that this is not the case. Rodet and Roux have already made a similar, to me, incomprehensible statement. (See the Transactions of the London Congress on Hygiene, Vol. II. p. 273). Dr. F. W. Andrewes has, moreover, succeeded in isolating the typhoid bacillus from the sewage passing out of a London Fever Hospital.

Now, what are the morphological characters of this bacillus, and what are the essential differences between it and the bacillus coli?

(*a*). The typhoid bacillus is distinctly more cylindrical than the bacillus coli, its average length being 2—4 μ; it forms in cultures cylinders and filaments.

(*b*). Its motility is decidedly greater, each bacillus being surrounded by numerous flagella.*

(*c*). It grows less quickly than the bacillus coli on the surface and in the depths of nutrient gelatine, as also in gelatine plates.

(*d*). When growing on the surface of gelatine, either in tubes or in plates, it forms a peculiar iridescence which is not observed on similar culture of the bacillus coli.

(*e*). It does not form gas bubbles in gelatine shake cultures.

(*f*). It does not curdle milk.

(*g*). It grows well in broth, but does not form indol.

(*h*). It grows well in twenty-five per cent. gelatine, but unlike bacillus coli, makes the gelatine uniformly turbid in as short a time as after twenty-four hours.

The three principal cultural characters, however, by which the two organisms can be distinguished best and easiest, are:—Shake cultures in gelatine, milk cultures, and broth cultures. While the bacillus coli rapidly forms gas bubbles in gelatine shake cultures, the typhoid bacillus does not do so; while the bacillus coli curdles milk, the typhoid bacillus does not do so; and while the bacillus coli produces indol in broth cultures, the typhoid bacillus does not do so. There is nothing easier than to demonstrate these facts in a simple way.

A plate cultivation in gelatine is made from a typhoid stool, or from sterile water or other fluid to which previously a trace in each instance from a culture of bacillus coli, and from a culture of typhoid bacillus has been added. After several days' incubation at 20° C. such a plate presents numerous colonies, apparently of the same kind; those that are growing on the surface of the gelatine, possess the same kind of translucent filmy appearance with irregular outline, thin at the margin, thick and less translucent at the centre. Those that are growing in the depth of the gelatine appear as dots, whitish in reflected, brownish in transmitted light. From a superficial examination it would be difficult to say whether these colonies are those of bacillus coli or typhoid bacillus, or of both; but on more careful examination it is seen that some of the surface colonies are less translucent and considerably larger than others, and that they possess a more irregular outline than others. Now, on making microscopic specimens of these large colonies, it will be seen that they are mostly short oval rods, amongst which few only show active motility; whereas preparations made of the small translucent surface colonies show longer cylindrical bacilli and filaments possessed of vigorous and brisk motility. By making of the two kinds of colonies the sub-cultures just mentioned, viz., in gelatine shake cultures, in milk and in broth, it becomes soon apparent that they represent two definite species, and if from such sub-cultures further sub-cultures in those media are made, through however many generations, the differences just enumerated of the two species will appear to be constant and permanent. More than that, I have in two instances by the above means been able to ascertain and to identify the simultaneous presence in water of the bacillus coli and the bacillus of typhoid fever.

---

* Report of the Medical Officer of the Local Government Board, 1892—93, p. 348, and *passim*. Plates I.—VII.

It will be in the recollection, of many here present, that a serious epidemic of typhoid fever occurred in Worthing during the spring and summer of 1893, and it is no doubt known to you that Dr. Theodore Thomson with Dr. Kelly, the able Health Officer of Worthing, investigated this outbreak. Dr. Thomson's report has been recently issued by the Medical Department of the Local Government Board. He clearly shows that the then existing water-supply of the town (the town of Worthing is now, and has been for some time past, supplied from a fresh and good well) had become polluted, that a percolation into the old well had taken place from some old disused sewer. Now in this, as in most cases of water pollution, it is always a question of great dilution of filth by a large bulk of water. To search then for the particular microbe of typhoid fever in such water can be attended with success only if a large volume of the water be subjected to bacterioscopic analysis. I have shown that when large volumes (1,000, 1,500 and more cubic centimetres) of this water were thus analysed they were found to contain an abundance of the bacillus coli and a limited number of the typhoid bacillus. The two species were easily isolated, and they presented the well-marked differences stated above. Sub-cultures of these two species taken from the Worthing water were carried on for many generations, and there was no indication of a change in their character, or of a change of the one into the other. A similar positive success was obtained from a polluted well which yielded a part of the water supply of Rotherham, in Yorkshire.* Here, also, on the above lines of examination, an abundance of bacillus coli and a limited number of the typhoid bacillus were demonstrated."

So that in these instances the two species co-existed in the water, and by the above-mentioned characters were readily distinguishable one from the other.

"In the examination by MM. Rodet, Roux, and Vallet of the suspected water of Lyons, small quantities only were used for bacterioscopic examination, and it is not to be wondered at that they failed to find the typhoid bacillus; they isolated the bacillus coli only, and at once arrived at the conclusion that it is this bacillus coli which had caused typhoid fever in the consumers."—Transactions of the Seventh International Congress on Hygiene, London, 1891, Vol. II., p. 272.

A similar criticism may be applied to a paper by Sir Charles Cameron and Dr. McWeeney (*Journal of State Medicine*, Vol. II., No. 3, p. 89), in which these authors describe, in water, which was under suspicion of having conveyed typhoid fever, a species of bacillus which, from their description I submit, was clearly a variety of bacillus coli.† They state that their bacillus was intermediate between bacillus coli and the bacillus of typhoid fever. They did not test its behaviour in milk, but from the facts stated by them that it formed abundance of gas bubbles and that it gave indol reaction, I am prepared to assert that this organism was neither the typhoid bacillus, nor any bacillus allied to it, but that it was simply bacillus coli.

Now it must clearly be understood that I do not mean to deny the possibility of the existence of intermediate forms, both morphological and cultural, between bacillus coli and the bacillus of typhoid, but what I do maintain is that as far as direct observation at present goes, the bacillus coli and the bacillus of typhoid fever are two well defined species, and that there has not appeared under the many and diverse conditions of laboratory experiments any evidence of transitional or intermediate forms between the one and the other species.*

---

* The Town Council of Rotherham, much to their credit, immediately on learning of this result, made it public.

† These authors, be it noted, used for the detection of this bacillus very minute quantities of the water, not more than ten drops (l. c. p. 90). The same remark applies to Rodet, Roux, and Vallet. (l. c.)

I come now to the important evidence of the animal experiment. In the statements made by various authors as to the alleged intimate relation between the bacillus coli and the typhoid bacillus, great stress is laid on the fact that the cultures of both these microbes when injected intraperitoneally into guinea-pigs produce the same acute disease and death. I have shown † that a variety of the most different microbes, such as the bacillus prodigiosus, the proteus vulgaris, the staphylococcus aureus, the vibrio of Finkler and of Koch, all produce under like conditions (*i.e*, when injected intraperitoneally into guinea-pigs in sufficient doses) one and the same disease and death from acute peritonitis between sixteen and twenty-four hours. The peritoneal cavity contains fluid exudation in which the microbes have multiplied to a very large extent, and the blood also as a rule contains the microbes. From the fact that the bacillus coli and the bacillus of typhoid act under these conditions alike pathogenically on guinea-pigs, no conclusion can be drawn as to their identity or non-identity, seeing that in these respects they stand in exactly the same position as the other species enumerated. It has been stated by Kellog (l.c.) that the bacillus coli when passed through the animal body—that is, in the above intraperitoneal injections of guinea-pigs—assumes virulent properties and changes into the bacillus of typhoid. My experience on this point, extending over a considerable number of experiments, does not support such an assumption. I have passed cultures of the bacillus coli and bacillus of typhoid separately through a number of successive generations of guinea-pigs—that is to say, a definite fatal dose of a culture of bacillus coli or of bacillus of typhoid respectively was injected into guinea-pigs. These were found dead within twenty hours; the peritoneal exudation was crowded with the bacillus coli or bacillus of typhoid respectively. Of this peritoneal exudation a fatal dose was transferred to the peritoneal cavity of fresh guinea-pigs with the same result. The peritoneal exudation of this last generation was again transferred to further guinea-pigs, and so on through a considerable number of generations.

---

* When the bacillus coli and the bacillus of typhoid fever are placed in water they co-exist well together, as stated above, but it is observed that the bacillus coli is capable of preserving its vitality for a conspicuously longer period than the typhoid bacillus. In this connection it ought to be stated that the various assertions by different observers as to the rapid devitalisation of the typhoid bacillus are not to be accepted without comment, and are very much exaggerated. I have recently conducted an extensive series of experiments for the medical department of the Local Government Board on this subject, and I find both as regards the typhoid bacillus as also the cholera vibrio, that considerable differences exist between various waters (as for instance the various waters supplied by the London Water Companies - also rain water, lake water, deep well water) as to the vitality of these microbes in these different waters, and that the statements put forward as to the rapid devitalisation of these microbes in water are certainly exaggerated.

† Illustrated in the Report of the Medical Officer of the Local Government Board for 1892—1893, p. 374.

In these series of experiments no difference was noticed between the two microbes from the outset, as regards virulence and the general result on the guinea-pig. Nor did cultures made from the peritoneal exudation of all the successive generations of guinea-pigs show alteration, either in morphological or cultural respects, of the bacillus coli and the bacillus of typhoid respectively. The two microbes obtained from the peritoneal exudation of the last generation of guinea-pigs in the series showed exactly the same morphological and cultural differences as those obtained from the peritoneal exudation of the first generation of the series.

All authors who maintain the change of the bacillus coli into the bacillus of typhoid fever assume that this change is accomplished in sewage. As far as direct experiments can be made in this direction they lend no support to this view, for it can be shown that the two microbes while sojourning in sewage maintain their biological characters unaltered. Moreover, direct observation proves that the two organisms when planted into sewage behave in a strikingly different manner. While the bacillus coli retains its vitality there and undergoes mutiplication, the bacillus of typhoid fever, on the contrary, shows considerably less vitality and, unlike the bacillus coli, soon diminishes in numbers till ultimately it altogether disappears, in some cases within a fortnight, and long before the nutritive material is exhausted.* But as long as the typhoid bacillus is present in such sewage it retains the same cultural characters as mentioned above, and the same applies also to the bacillus coli. In a large number of experiments made in this direction I have not noticed the slightest deviation of character in either of these microbes. Bacillus coli was sown into sewage and from day to day and from week to week the cultural characters of this microbe were tested:—By plate cultivation; in gelatine shake cultures, as to gas production; in milk, as to curdling; and in broth, as to indol production. But no alteration was noticed, the microbe remained the typical bacillus coli. A like series of experiments was also made with the typhoid bacillus; but, as mentioned just now, this latter is of more limited duration of vitality in sewage than the bacillus coli. It soon shows diminution in numbers and ultimately diappears, but as long as it is present it possesses, when tested by cultures, the same characters as the typical typhoid bacillus.

---

* A series of observations in this direction is being conducted by Mr. W. F. Andrewes and Mr. Parry Laws.

An important fact that has resulted from these experiments in sewage is that the typhoid bacillus when planted in sewage to which potassium nitrate is added (1 per cent.) retained its vitality for a considerable period and underwent rapid and conspicuous multiplication.* But here also, when tested by culture at various periods it is found to retain its characters unimpaired. It does not form gas bubbles in gelatine shake cultures, it does not curdle milk, and does not form indol in broth. From all these considerations it follows then that the belief, that the non-specific bacillus coli is capable of changing into the specific bacillus of typhoid fever or *vice versâ* has no sufficient basis in observed fact; that it is indeed contradicted by direct experiment. As far, then, as bacteriological evidence goes, there is no valid reason why sanitarians should not continue to regard typhoid fever as a specific disease derived from an antecedent case or cases of the same disease, and not, as has been suggested, on bacteriological evidence alone, as being capable of originating *de novo*, that is to say, through the bacillus coli. While holding this view our duty of preventing pollution with sewage of drinking water, milk, &c., is not less incumbent. For although without the typhoid germ the bacillus coli, we maintain, is not capable of causing typhoid fever, the presence of bacillus coli in water nevertheless indicates a probable pollution with excremental matters and amongst them possibly with specific, *i.e.*, typhoid excremental matter.

---

* This seems capable of explaining the observations often made, namely: that the typhoid bacillus in sewage percolating through the soil into water is capable of preserving for long periods its vitality. Sewage percolating through the soil takes up nitrates from the soil, hence, in such a medium, the typhoid bacillus is capable of growing and of retaining its vitality.

SECTION II.

ENGINEERING AND ARCHITECTURE.

ADDRESS,

By GEORGE F. DEACON, M.Inst.C.E., M.Inst.M.E., F.R.Met.Soc., &c.

(Member.)

PRESIDENT OF THE SECTION.

The request that I should preside over so important a section of this great Congress has caused me considerable embarrassment, when contemplating the magnitude and intrinsic difficulty of the theme, and the impossibility of doing justice to it.

I would add also that no small hesitation has been due to the traditional, and I trust it will be thought honourable, disinclination of a professional man to concern himself with other people's business. While I sincerely trust that that tradition may never become less powerful for good, I cannot but recognise the duty of an engineer, whose avocations bring him largely in view of different classes of work and different methods of management, to reveal at least the general nature of the defects which may come under his notice.

It is natural—and it will no doubt be expected—that this great city, in which for twenty-five years, beginning in 1865, I was professionally engaged, should receive the first share of my remarks, and it is natural also that a later portion should be devoted to the Metropolis, to which some years ago I gravitated, in that spirit of evil centralization, which, as sanitarians, we all so greatly deplore, but nevertheless recognise as an inevitable incident of modern life.

In his masterly address as President of the Health Section of the Social Science Congress held in Liverpool eighteen years ago, the late Mr. Thomas Hawksley pointed out that the habit of sanitary philosophers to regard the health of Liverpool as exceptionally and pre-eminently bad, was even then not justified. Mr. Hawksley compared the state of Liverpool with the state of the other large cities most nearly approaching her in magnitude, namely, Manchester and Glasgow, showing successfully that even at that time the comparison was favourable to Liverpool;* and if we continue the investigation we find that from 1876 the relative death-rate of Liverpool has very materially decreased.

But, when in conjunction with these facts, we take into consideration the circumstance that the mean density of the population of Manchester and Glasgow, though lower in 1876 than that of Liverpool, has decreased (owing partly to the extension of boundaries) much more rapidly than in the case of Liverpool, and that the absolute density of Manchester is now only 40 per cent. and of Glasgow only 58 per cent. of that of Liverpool, the significance of the change becomes still more striking. Thus according to the Registrar-General's returns the number of persons per acre at the different dates have been as follows:—

	1871	1876	1893
Liverpool	97·0 ...	100·1 ...	97·9
Manchester	78·0 ...	83·4 ...	39·9
Glasgow	95·0 ...	90·4 ...	57·3

If instead of considering the total mortality in the towns very appropriately compared by Mr. Hawksley, we regard only the deaths from those zymotic diseases which are chiefly affected by sanitary conditions,† and make the comparison with the seventeen large towns and cities of England for which—in addition to Liverpool—the Registrar-General in 1872 enumerated the zymotic diseases separately, we find an equally satisfactory improvement.‡ In the following Table I place before you such a comparison:—

---

* Notwithstanding the much greater density of the Liverpool population, the death-rate during the seven years prior to 1876 was one-and-a-third per cent. lower than that of Glasgow, and identical with that of Manchester, even excluding Salford, where it was much higher.

† The diseases included are enteric fever, typhus, simple and ill-defined fevers, diphtheria, diarrhœa, dysentery, scarlet fever, and measles.

‡ I am unable to extend the comparison to earlier years, as the separate records only appeared for the first time in the Registrar-General's returns for 1870.

	Deaths from the Zymotic Diseases in question per 1000 persons living.			Ratio of density of population in Liverpool to that of other towns.	
	Seventeen large towns and cities separately enumerated by the Registrar General.	Liverpool.	Excess of Liverpool over mean of other towns.	Actual.	Multiple
Six years prior to 1876 —1870 to 1875 ...	3·42	5·38	1·96	(1871.) 97·0 : 29·8	3·25
Six succeeding years—1876 to 1881.........	2·71	3·695	0·985	(1876.) 100·1 : 32·7	3·06
Remaining twelve years —1882 to 1893......	2·216	3·122[*]	0·906	(1893.) 97·9 : 31·6	3·1
Means since 1876.........	2·38	3·31	0·93	101·95 : 33·76	3·0

It thus appears that, compared with the other seventeen towns having a density of population only one-third that of Liverpool, the excess of mortality in Liverpool from the diseases in question, which prior to 1876 was nearly 2 per 1000, has, from 1876 onwards, been less than 1 per 1000.

If now, instead of investigating the mortality returns of the great towns of this country, and discovering by that investigation that, at or about the beginning of 1876, a change took place for the better in the health of Liverpool which was not equally shared in by the mean of the other seventeen towns, we study the history of her sanitary engineering—of the physical development of those principles upon the importance of which we, as sanitarians, are substantially agreed, what do we find? Running over the various operations cf the whole twenty-five years, we notice, for example, that remarkable activity was shown between the years 1871 and 1875.—Let us begin with the Water Supply. From the year 1865 the supply had been intermittent, under conditions which, as I had occasion to report at the time, and firmly believe now, caused impurities of the most serious kind to find access to the mains during the intermissions, and to be delivered to consumers on each occasion of the resumption of supply.

---

[*] The considerable error in the estimated population of Liverpool during the decade 1881-91 which was discovered by the census of 1891 does not affect these figures. They have been duly corrected in accordance with the census.

In 1874 the remedy for this state of things was begun.* On the last day of 1875, every district of Liverpool had been provided from the old sources with a constant supply of water under higher pressure than before. On that day the valve of the last intermittent district was turned full open with much circumstance and rejoicing, by the then chairman of the water committee, the late Mr. J. H. Wilson, to whose energy and steadfast conviction was largely due the completeness of the success attained; and thus before our critical year of 1876, Liverpool had received the full blessing of a constant supply, which has rarely been interrupted since.

To turn now to the sewerage:—

It had been the dream of my predecessor, the late Mr. James Newlands (the first Borough Engineer created, for he like his successors held office under a special Act passed in 1846)† to seal hermetically the whole of the sewage directly it passed into the drains. It was a greatly to be desired vision, but one which, as we now well know, never could have been realized.

How far it was realized in practice, it became in 1871 my duty to enquire.

Liverpool is, as you see, a hilly city, and while the whole of the main sewers discharge into the estuary of the Mersey at about the mean tide level, their higher affluents reach elevations of about 220 feet. As a natural sequence to the idea of air-tightness of the materials of the sewers and drains, it had been long asserted that the seal of the water traps in the higher parts of Liverpool was constantly broken, owing to the displacement of sewer air by the accumulating sewage during each rising tide. It appeared to me (from considerations based upon the relative volume of sewage accumulated while each sewer was tide-locked, in comparison with the total capacity of the sewers; and upon the approximately known degree of permeability to air of the materials of which the old sewers and drains are made), that any sensible increase of pressure from this cause was quite impossible. But conclusive experiments were made, with the result that the water barometer failed to show the slightest indication of increasing pressure during a rising tide. Subsequent trials with a delicate anemometer made in various sewers showed that, except close to the outfalls, the rising tide had absolutely no influence upon the direction of the flow of air. The sewers were already quite pervious; but more than this was necessary. It was essential that there should be a flow of pure air into them, and accordingly before our critical year of 1876, the system of ventilation now in operation, consisting simply of the familiar open grid in the middle of the carriage-way, had been largely carried out. But this work was not undertaken without first considering, in each case, the internal condition of the sewer to which it was to be applied. Except when actual renewal was called for, the worst sewers were thoroughly repaired, and provided where necessary with new inverts of Portland cement. Sewers so treated and others in good condition were then ventilated, without causing the slightest nuisance except in the neighbourhood of places where they were used for the discharge of hot water or steam. By my immediate successor Mr. Dunscombe and by his successor Mr. Boulnois this work of sewer renewal has been most ably continued. It possesses features which were I believe novel when the work was begun, and which so far as I know have not been adopted elsewhere. I commend them to the attention of all engineers who have to deal with old sewers.*

---

* The preliminary experiments were begun in 1873, but it was not until July, 1874, that the systematic treatment of the whole City, after the manner which those experiments showed to be desirable, was authorized.

† The Borough Engineer of Liverpool, whose appointment is subject to the approval of the Secretary of State, holds office under the Liverpool Sanitary Act of 1846. The general Act under which the City and Borough Surveyors hold office is the Towns Improvement Act of 1847.

The principal other sanitary work, carried out before our critical year of 1876, was the removal of the cellar water taps and the closing of the cellar drains in a large proportion of the houses of 1674 courts occupied by the lowest classes. These private drains and their traps were generally defective, and the work of closing them was done by the Corporation as the result of a bargain with the landlords concerning the supply of the substituted water fittings—suggestive instance of the advantage of municipal control of waterworks.

Before the same critical date many other sanitary improvements were made; impervious paving for example was introduced in 1871 and has since been rapidly continued; but the changes of greatest importance I have already enumerated; and it is impossible not to be struck by their coincidence with the great comparative reduction of zymotic and general mortality. The conclusions I leave to others, only remarking that it must be exceedingly satisfactory to the people of this great city to know that the reputation for pre-eminently bad health has long ceased to be merited, and that when properly compared with other similar places the health of Liverpool takes a high position.

---

* See the following reports on the subject:—

"The Condition and Ventilation of the Sewers," by George F. Deacon, 10th April, 1873.

"Liverpool Sewers," by Clement Dunscombe, 20th January, 1886.

"Liverpool Sewers," by Clement Dunscombe, 31st December, 1889.

Liverpool has the good fortune to be situated upon a great estuary, and to experience but little difficulty in disposing of her refuse. The liquid sewage is discharged into a wide and deep channel, which also receives and discharges twice daily during neap-tides, 282,000,000 cubic yards, and at spring-tides no less than 700,000,000 cubic yards of water—volumes so enormous in relation to the sewage that, prosper as Liverpool may, there can never be any sound objection, if the outfalls are properly chosen, to maintaining the present condition of things. The population within the watershed of the Mersey is less than twice that within the watershed of the Thames above Molesey, near which place 70 per cent. of the London water-supply is drawn, while the mean ebb of the Mersey is about 140 times that of the mean discharge of the Thames past the same place.*

Again, as regards the disposal of solid refuse, Liverpool is well placed. In 1871, when I was first called upon to inquire into the matter, all such refuse was sent away by railway or canal or used for filling up clay pits.

In 1872 I used with success a considerable quantity of ash-pit refuse for the purpose of raising steam, through the medium of a mechanical firing apparatus, at one of the Liverpool pumping stations, and shortly afterwards constructed at the disused pumping station in Devonshire Place an experimental regenerative furnace for the burning—or, as it is now called, the *destruction*—of town refuse. The furnace was perfectly successful, and the only difficulty—certainly in a right direction—was the high temperature obtained, which resulted in the formation of heavy clinker and the somewhat rapid wear of the furnaces. From the chimney of this *destructor* there was never the least smoke. At that time, or a little later, I believe others were working in the same direction, though we were not aware of it in Liverpool. The possibility of conveying this refuse to sea was also investigated, and in the same year I recommended the adoption of a steam hopper barge of novel construction for this purpose. It was not however until 1879 that the "Alpha" was designed and built. She carried 380 cubic yards, and on reaching her destination in the outer estuary of the Mersey beyond the bar, at a distance of about twenty-two miles from the Liverpool landing-stage, deposited her load in a few seconds in deep water.

---

* It is scarcely necessary to point out that this comparison is true only of the tidal estuary of the Mersey, and does not relate to higher portions of the river.

At that time it was soon seen that the low cost of this mode of disposal left little room for the successful competition of "destructors," and for a time burning was suspended. All the refuse within a short distance of the docks could be sent to sea more cheaply, and landward there were still some economical outlets left. The "Alpha" is still in full work and was joined in 1884 by the "Beta," carrying 530 cubic yards, thus bringing up the carrying capacity to 910 cubic yards. But with the rapid extension of suburban Liverpool, the available outlets in a landward direction have year by year diminished, and the present City Engineer, Mr. Boulnois, has very successfully revived the destruction of a portion of the refuse by fire. There is absolutely no objection to tipping this refuse in deep water, and where it is the cheapest it is the best course to adopt. Where it is not the cheapest, destruction by fire, with proper precautions, is from a sanitary point of view quite satisfactory. The combustion may be made complete, and there need not be a sign of smoke.

These considerations lead me to say a few words regarding the sewerage of those numerous places which are not so fortunately situated. In recent years, as a consequence chiefly of renewed vigour in compliance with the Rivers Pollution Act of 1876, the progress of sewage treatment in its many forms has received a great impetus. I am not going to discuss the vexed question how far interference with the interest of trade should be carried in enforcing the provisions of that enactment, but I do wish to express emphatically the view, that when a method of purification, whatever the class of sewage to be treated, has been adopted and proved to obtain a given result, that method should be worked in all seasons, and, except in those cases where no harm can result from the omission, by night as well as by day. When this is not done, any single examination of the effluent is almost certain to be misleading. But it is to the *degree* of purification consequent upon the construction of the works rather than upon their management that I desire more particularly to refer.

First then concerning the sewers between the town and the place of treatment. These it is an exceedingly rare thing to find even approximately water-tight, and when they lie in pervious ground wholly or partly beneath the sub-soil water level, they take in the sub-soil water to an extent which varies from any small quantity up to many times the flow of sewage due to the water-supply. Yet approximate water-tightness is one of the first conditions necessary to economy and efficiency. If the sewage is to be pumped we ought not unnecessarily to increase the quantity to be pumped; and whether pumped or not, we ought not to make the sewers larger and more expensive than for their legitimate uses they need to be; moreover, we ought not, if it can be avoided, to dilute the sewage with rain-water before proceeding to treat it. If once we admit the small-pipe system there is no reason whatever why the pipes should be large enough to carry much more than the intended quantity without filling. When properly laid, indeed, no harm will happen if the main pipes do fill, and the few inches of extra head thus produced engenders a beneficial velocity.

But I have heard it said that approximate water-tightness in sewer work is impracticable unless one uses iron pipes, and that it is cheaper to take in some of the subsoil water than to do this. As a matter of fact approximate water-tightness whether in concrete work or in stoneware pipe work is perfectly practicable, and that without undue cost. To take an extreme case: a concrete culvert 4 feet 6 inches diameter, 18 inches thick and about half a mile long, properly constructed with gravel and Portland cement in the proportions of 6 to 1, has been found almost absolutely water-tight under an external pressure of 55 feet of water; and stoneware pipes with non-rigid joints have been laid rapidly and economically under all sorts of differences of earth pressure, and have been found equally water-tight under any pressure at all likely to be brought upon them either internally or externally.

I have spoken of non-rigid joints, and although in an address of this sort it is not desirable to enter into details, I may be permitted, in view of the very great importance at the present time of this question of sound sewer construction, to point out that—except in very shallow trenches and suitable ground—you cannot, speaking generally, without greatly increased cost, make stoneware pipes with rigid joints permanently water-tight. Even cast-iron pipes are commonly broken by irregular external pressure in deep trenches under the conditions to which stoneware pipes are sometimes subjected. As an example, stoneware pipes of fifteen inches internal diameter of good manufacture, jointed with Portland cement, and supported on bearings 8 feet 6 inches apart, will only deflect, before fracture, one-thirtieth of an inch. An ordinary cast-iron pipe will deflect a great deal more than this, and is at least thirty times as strong; but as the stoneware pipe, if properly constructed and laid, may be made entirely satisfactory, there is no object in employing the more expensive material. In most trenches more than a few feet in depth, the unbalanced pressures (caused by irregular settlement of the filled-in materials, which, with the greatest care, cannot be avoided) largely exceed what is necessary to produce a flexure of one-thirtieth of an inch in 8 feet 6 inches of cement-jointed stoneware pipes: thus we find in a large proportion of such work that the pipes are frequently fractured. We also find that with the closest inspection it is most difficult to secure water-tightness in ordinary cement-made joints.

In 1869 Mr. William Williams, a very ingenious member of the Corporation of Liverpool, patented a joint for cast-iron pipes on the principle, not of the ball and socket, but of the sphere and cylinder, and that principle has since been applied to stoneware pipes. Under certain conditions to be attained by sufficient and intelligent inspection, and by the use of proper jointing material and special, but simple, pipe-laying apparatus, the principle of such joints may be employed with perfect success and even with economy in first cost. Pipes so jointed may be rapidly laid in any ground. The spherical segment and its containing cylinder admit both of flexure and longitudinal extension, and if the jointing material is satisfactory it will permit, as I have ascertained on a large scale, of far more movement than in practice ever occurs while the ground is settling down, and that without any leakage even under pressure, and I have no doubt other methods of securing the same end may be devised. This being so, it is to be hoped that engineers will in future insist upon water-tightness—not merely upon the insertion of the word in the specification, but upon the antecedent conditions necessary for its attainment—and upon its actual accomplishment by the contractor.

As I have already said this absence of water-tightness is a serious matter in point of expense. It is a still more serious matter in its sanitary aspect, especially in works where the sewage has to be lifted from one level to another and the pumping ceases during the night. With sufficient storage near the pumps, placed entirely below the sewer level, this cessation of the pumping at night may perhaps be permitted without serious objection, but sufficient storage is not usually provided, and as a necessary consequence, the night sewage backs up and is thus put under pressure in the main sewers, which are in the majority of cases, as I have said already, fractured or otherwise leaking in many places. Thus, if the ground is permeable, the engineman arrives in the morning to find that the work to be done by his pumps is not seriously greater than later in the day. The sewage in short has already been discharged into the gravel, sand, or other pervious subsoil. The local authority has properly gloried over the closing of a multitude of cesspools, and has unwittingly substituted for them one elongated cesspool discharging its contents nightly into the receptive soil below.

The next point of common defect is the failure to properly separate the rain water. The importance of this is greatest where there is any chance of the river water being supplied for drinking. In many cases where the separate system is nominally employed, no attempt is made to keep the roof-water out of the new sewers, particularly on that side of the house where the closet drain issues, and in others the attempt is imperfectly made. The consequence is, either a still larger discharge into the subsoil *or a demand for overflows from the new sewers direct into the stream or river, by which means the sewage if not taken by the subsoil, passes untreated to the stream whenever the pumps are stopped except for short intervals.* I confess I think—that where human beings are dependent for their water supply upon the river below—the Authorities have been wrong in permitting such overflows. Then we have the pretty well-known fact that even if, in the process of change from the old drains or cesspools, the closet drains are all turned into the new channels, subsequent additions to old premises, often not sufficiently inspected, sometimes result in the closets being connected with the old drains, which discharge their contents untreated into the stream.

There is certainly room for great improvement in these matters; but we cannot hope to attain even approximate perfection. The thought of this, and of inevitable increase in the density of ourpopulation, emphasises in my mind the very strong feeling that for our supplies of potable water we ought, so far as possible, to go beyond the limits of human habitation.

Returning to Liverpool I find it necessary to revert to the Water Supply. I have told you how on the last day of 1875 the system of constant supply was completed, but I have not told you the nature and full significance of the work by which that end was attained. All town supplies of water are divided, as we now know, into two parts:—

1st. That part which reaches the water fittings and is actually made use of by the consumers.

2nd. That part which leaks from the pipes, joints, and fittings, and may do evil, but cannot benefit anyone.

Experience of a large number of water supplies, in this country and abroad, has satisfied me that, on the average, the second division—that is, the water lost by leakage—is the larger of the two.

It should be distinctly borne in mind, that when intermittent service is resorted to, it is not with the object of curtailing the *supply*, properly so called, but of curtailing the waste; the second division is reduced: the first remains practically unchanged. Thus, for example, if the water required to satisfy each of the divisions is equal in amount, and we cut off the whole supply for twelve out of the twenty-four hours, we shall theoretically save 25 per cent., because, while the people will not use less water, half the supply, viz., the division which goes to the leaks, will only continue for half the time: and this, under the conditions assumed, is substantially what happens in practice with all the insanitary results attendant upon intermission of pressure in the mains. Now, if in any other way we can prevent the loss of this 25 per cent. of the whole supply—that is, 50 per cent. of the portion that supplies the leakage—we shall clearly be able to give constant service with substantially the same expenditure of water, that was formerly required to give only twelve hours service out of the twenty-four, and if we can save a still larger proportion of the 50 per cent., formerly lost, we shall not only be enabled to give a constant supply, but shall do so with an economy of water also.

This is precisely what was done in Liverpool in 1874 and 1875. *The water which had been formerly saved by curtailing the period of leakage, and of supply for consumption alike, was then saved by reducing the number of leaks without curtailing either the period of leakage or the period of supply for consumption.* The sanitary benefits of this constant internal pressure, of a pressure always much above that of the atmosphere, rendering impossible the accession of foul matter to the mains which so commonly occurs—when, during intermissions of supply, the internal pressure falls below that of the atmosphere—scarcely admit of exaggeration; and so strongly has this been felt in Liverpool that all new supplies are connected under constant pressure, and—except in cases of rare emergency—the water supply is now never cut off from any district or main. Of such a change, in so short a time, Liverpool might well be proud, but when it is known that after paying all the expenses of that change, none of which were charged to capital, a great revenue has been derived from the sale of the water formerly lost through the leakages of which I have spoken, there is cause not only for pride but jubilation. The facts are not difficult to apprehend. Comparing the mean supply of the four years prior to 1874 with that of 1876, when intermittent service had entirely ceased and a constant service under increased pressure had taken its place, we find that in 1876 the loss by leakage had already been so far moderated that a supply was given for metered trade purposes, increased by 25 per cent., and without restriction for domestic and all other purposes, to a population already increased by 33,000 * persons, with 12 per cent. less water than in the previous period. When to this I add, that the revenue went on increasing from additional water sold to new populations and to new trade consumers, who continued to be supplied from constantly increasing savings of the water formerly lost by leakage, you will understand the otherwise inexplicable fact, that without any increase in the charges for water, Liverpool continued from the year 1880 up to the year 1889 to pay the interest upon the expenditure, amounting at that time to more than £1,750,000, incurred in connection with the great scheme of water supply which was opened and brought into use in 1892; and so important had the surplus thus realized continued to be that even now, after the expenditure of 2¼ millions upon the new works, the charge for domestic water supply—nearly two-thirds of the whole—has only been increased (and that temporarily I think) by 1½d. in the pound, while the charge for manufacturing supplies—about one-third of the whole—has been reduced from 9d. to 6d. in the pound. Never, I believe, in the history of waterworks, has a financial condition so satisfactory in all its bearings accompanied the completion of new works, the interest upon the cost of which has been defrayed entirely from the revenue of the water-works undertaking.

I make no apology for referring to financial success of this kind in an address devoted to sanitary advancement for assuredly when we can thus combine the two, the incentive to the higher ambition will be increased. The case of Liverpool, it may be said, must have been exceptional. A pretty large knowledge of the works of this country, and of many of those on the Continent, enables me to assert that this is not so. In many other places equally satisfactory results have been attained, and there are still many in which with proper personal attention similar results can be attained, but active personal attention, I would almost add enthusiasm, on the part of someone properly qualified in relation to the magnitude of the undertaking, and determined to make his work a success, is a prime necessity. To Liverpool such services have been most ably and completely rendered by Mr. Joseph Parry, the present Water Engineer, who from its inception took a leading part in the organisation and management of the work which has brought about the remarkable changes I have explained to you.

---

* The increase of population from the mean of the four years was 49,155, but I have only taken credit for it from 1873, though considerable reduction was effected by experimental work done in 1873.

In this, as in many other particulars, it would be difficult to over-estimate the value of Mr. Parry's services to the Water Estate.

Of the great supply of water which Liverpool has thus so cheaply secured from the River Vyrnwy, in Montgomeryshire, there is little time to speak to you. I will, therefore, only observe that it is drawn from a source of the greatest possible purity, so far as organic matter of animal origin is concerned; that, as delivered to the consumer, it is free from any other impurity which can render water unwholesome, hard, or unpleasant to the sight, and that it is abundant in quantity. In the following table I have recorded some of the principal features and dimensions of the work.

Lake Vyrnwy, formed by damming up a valley originally occupied by a post-glacial lake since silted up.
Height of overflow above the sea .. .. .. 825 feet.
Area of lake .. .. 1,121 acres.
Length .. .. 4¾ miles.
Width .. .. ¼ to ⅝ of a mile.
Volume of water contained above the level down to which the lake is designed to be drawn off .. 12,131 million gallons.
Greatest depth to alluvial deposits at bottom of valley 84 feet
Drainage area contributing directly to the lake 18,000 acres.
" capable of being diverted to the lake .. 5,200 "

(NOTE.—These areas are for the most part mountain moorland on the upper and lower Silurian formations.)

Masonry dam, length from rock to rock .. .. 1,172 feet.
Height from lowest part of foundation rock to parapet of carriage way .. .. 161 feet.
Volume of masonry .. .. .. 260,000 cubic yards.
Statutory compensation water, about .. 13½ million gallons daily.
Available supply to Liverpool when the three lines of pipe of which the greater part of the aqueduct consists have been completed.. .. .. more than 40 million gallons daily.

(NOTE.—All works for the first instalment, together with the great reservoir, the tunnels, and certain other aqueduct works for the three instalments were constructed, and were in use when the works were opened in 1892.)

Distance measured along line of aqueduct from Lake Vyrnwy to the Liverpool Town Hall .. .. .. 77 miles.
Length of Vyrnwy aqueduct from the lake to the service reservoirs at Prescot .. .. 68¼ miles.
Number of balancing reservoirs on the line 5
On the line of aqueduct (besides several rivers), five canals, eleven railways, and one navigation were crossed; but the most serious undertaking was the tunnel through water bearing silt and sand under the Mersey.
The water is filtered near Oswestry.

When speaking of the means by which the sanitary and financial success which I claim for Liverpool had been attained, I stated that many other places may still be similarly benefited: London, the greatest of all, is not an exception. Exact experiments in different parts of the metropolis have demonstrated (what our general experience in other places, combined with our knowledge of the immutability of natural laws, had previously rendered quite certain), that the same policy could be applied in connection with the London Water Supply and with the same success. That supply is now in the hands of eight great companies. I am not going to suggest for a moment that as trading companies, and subject to the pressure which has been brought upon them by the very wise institution under the Board of Trade of an independent officer, known as the Water Examiner, with the monthly analyses and reports for which he is responsible, these companies have not performed their duty as well, as or even better than, companies of the kind generally do. Seeing—as I so constantly do see—the marked differences which characterize the management of various Municipal and Local Authorities throughout the country, I shall not even suggest that municipal management in matters of water supply is of necessity better than the management of trading companies, but I feel very strongly that the water supply of the Metropolis will not be placed upon a satisfactory footing until it is worked entirely in the interests of the consumers.

The history of the companies, even since the Metropolis Water Act, 1871, was passed, abundantly supports this view. The cumbrous processes of that Act are due to the opposition of the companies to a constant supply, except upon certain unnecessary conditions as to the state of the fittings antecedent to the application of that constant supply, and the result has been that after twenty-three years there are a million and a quarter persons in the Metropolis still receiving an intermittent supply. Liverpool, as a municipality, made up her mind in the matter in the beginning of July, 1874. In less than eighteen months, as I have already explained to you, the work of suppressing the waste to the extent necessary to afford a constant supply had been accomplished with financial profit; but Liverpool had attacked the problem very differently. She was happily compelled to do so, for no statutory power existed under which the private fittings could have been antecedently renewed. Constant service was given to one district at a time, containing perhaps 2,000 persons, and this having been done, the condition and suitability of individual fittings rapidly asserted itself. Under the system adopted there was little difficulty in detecting either the visible or hidden waste, and when waste was once detected there was power—though less effective power than exists in London—to suppress it.

In 1880 the Government, on the motion of Mr. (now Lord) Cross, the then Home Secretary, directed an enquiry by a Select Committee as to the expediency of confirming certain provisional agreements entered into by the late Mr. E. J. Smith, for the purchase of the undertaking of the eight London Water Companies, on behalf of the inhabitants of London. About three weeks later the Parliament under Lord Beaconsfield's administration was dissolved, and on June 3rd of the same year—after the assembling of the new Parliament—a Select Committee was appointed to consider and report upon the matter.* That Committee reported adversely to Mr. Smith's proposals. They reported also among other things:—

(1) "That it is expedient that the supply of water to the Metropolis should be placed under the control of some public body, which shall represent the interests and command the confidence of the water consumers.'

(2) "That under such management a greater efficiency economy, and equality of charge than that which at present exists might be secured; the defects in the present provision for the extinction of fire might be remedied, and better provision might be made for the health of the community."

(5) "That for certain purposes at least it would be desirable to acquire the undertakings of the existing Companies, if the same could be obtained upon fair and reasonable terms."

Nothing however of importance has since been done in this direction, but from time to time the Companies have obtained authority by private Bills for the increase of their capital which stands at something like £4,500,000 higher to-day than it did in 1879. No one I think who is familiar with the facts can now have any doubt that if the provisional agreements entered into by Mr. E. J. Smith had been confirmed in 1880, not only would the Companies have been amply repaid for their undertakings, but the financial wisdom of the bargain as affecting the people of London would before now have been abundantly demonstrated. As it was, for another long term, a state of things was resumed which no other great community in this country has permitted to continue. Had that scheme been carried out, there seems to me no manner of doubt that the same sanitary and financial advantages which have resulted from the policy of Liverpool, might with equal ease have been attained some years ago in connection with the water supply of London. This is no *ex parte* opinion, but the result of a careful comparison of the system of distribution in London and in Liverpool and many other places, and, as I have said, of exact experiment, which may be quite easily repeated in any isolated districts of the metropolis, small or large, chosen for the purpose, as was done in Liverpool more than twenty years ago.

---

* The Committee was appointed under the following order of the House:—
"That a Select Committee be appointed to enquire and report as to the "expediency of acquiring, on behalf of the inhabitants of London, the under-"takings of the existing Metropolitan Water Companies, and also to examine "and report whether certain agreements or any of them already entered into "provisionally for the purchase of these Companies would furnish a satisfac-"tory basis for such an acquisition, and further to enquire and report as to the "nature and extent of the powers of the Water Companies to levy water rates "and rents, and how far it may be desirable to modify the same."

In September, 1893, was issued the Report of a Royal Commission on Metropolitan Water Supply, which had sat on forty-five days and heard oral evidence upon thirty-two. The reference to that Commission was limited to an inquiry concerning the adequacy in quantity and quality of the present sources of supply of the companies, or of the supply to be obtained within the watersheds of the Thames and the Lee.*

Assuming the interpretation put upon this reference by the Commission to be the correct one, probably no careful reader of the very voluminous and most interesting evidence given before the Commission can doubt that the finding was substantially in accord with that evidence. That finding as you know was entirely in the affirmative as to the sufficient quantity and quality of the waters in question subject only to the condition that the river waters should undergo purification by means of subsidence and sand filtration to an even greater extent than at present. The Commission was not called upon to say that the continuance of the rivers Thames and Lee as sources of supply was the best course open to the metropolis. No expression of opinion of the kind was asked for, and very properly none was given. The weight of evidence was undoubtedly to the effect that the Thames and Lee, notwithstanding a population within their watersheds above the intakes of the companies exceeding one-and-a-quarter millions, yielded water which, if stored when in flood and if otherwise treated by the most perfect system of sand filtration known to engineers, would yield good and safe water, and this view is expressed in the Report as follows:—

---

* The exact words are:—"To inquire whether, taking into consideration the growth of the population of the metropolis and the districts within the limits of the Metropolitan Water Companies, and also the needs of the localities not supplied by any metropolitan company, but within the watersheds of the Thames and the Lee, the present sources of supply of these companies are adequate in quantity and quality, and, if inadequate, whether such supply as may be required can be obtained within the watersheds referred to, having due regard to the claims of the districts outside the metropolis, but within those watersheds, or will have to be obtained outside the watersheds of the Thames and the Lee.

> "Having regard to the experience of London during the last thirty years, and to the evidence given to us on the subject, we do not believe that any danger exists of the spread of disease by the use of this water, provided that there is adequate storage and that the water is efficiently filtered before delivery to the consumers."

In the sense in question, the water cannot of course be efficiently filtered if it contains pathogenic bacteria or their germs; and it is probable, I think, that under exceedingly stringent regulations efficient filtration can in this sense be attained. But I venture to think that no one who has made an exact study of sand filtration can doubt that there are likely to be lapses in the continuity of the required perfection. Consider only the primary conditions necessary. In any sand filter, as ordinarily constructed, fine gravel resting on coarser gravel supports in its turn a layer of sand, and just as it is the proper function of each layer to support the one above, so it is the proper function of the fine sand to support, on its surface, a thin film of finer mud and gelatinous matter deposited by the water itself, and until that film has been deposited the full efficiency of the filter is not attained. The late Dr. Tidy, though an eminent chemist and a specialist in matters of water purification, was not, I believe, a bacteriologist; but many years ago he had discovered this fact, which has since become so well-known, and he then stated to me his opinion that a sand filter must be in use for something like two days before its proper functions can begin, or that in the alternative it must at first be employed simply as a depositing tank. These and many other conditions such as those necessary to preserve without rupture that thin film (stretching in the case of the present London filters over more than 100 acres) upon which our safety depends, are of a kind most difficult to attain even where the staff is large and its organisation and control in the hands of competent experts, and which it is quite hopeless to look for in the filters of waterworks in small places.

Undoubtedly, the last few years have been pregnant with micro-organic discovery of great present importance, and of vastly greater promise for the future; but if there is one feature which strikes the observer as more remarkable than another in this initial stage of bacteriological research, it is the repeated announcements of specific facts in one year, and their complete subversion in the next. And when we consider that many of the conclusions of the Royal Commission were based upon the assumptions, the correctness of which still remains to be proved, it does seem to me to behove us to throw our weight against a policy which would substitute for waters such as those of Loch Katrine, of Lake Vyrnwy, or of Lake Thirlmere, other waters, for the supply of our great communities, the bacteriological purity of which has only been negatively determined, the constant quality of which is uncertain and the origin of which is impure.

I believe the particular limitation of the terms of the reference to the late Royal Commission to have been unfortunate, and the decision—though technically in accordance with the evidence as circumscribed by the reference, and therefore unaccompanied by any comparison with an initially pure source of supply—to be a misfortune not only as regards London, but as regards many places in this country.

The finding of the Commission leads to an inference diametrically opposed to the policy for very many years of the Local Government Board. Having given you the last pronouncement of a Royal Commission on this subject, I will now give you the last decision of the Local Government Board that has come to my knowledge and which seems to me to exemplify the inconsistencies into which we are drifting, though I do not suggest for a moment that the view of the Local Government Board was not justified.

The supply to which the decision of the Board relates is drawn from a river at a point nearly 400 feet above the sea, and cannot possibly receive drainage from the town supplied. The area drained by the river consists for the most part of mountain moorland rising to 3,000 feet above the sea and having within its watersheds a density of population equal to about one-eighth of that upon the Thames above the intakes of the Companies. The flow of the mountain river is, relatively to the area drained, very much greater than that of the Thames even in drought, and the land is much less cultivated. But owing to the pollution from this population, less than one-eighth of the density of that above the intakes of the London Companies, the Local Government Board, writing more than ten months after the Report of the Royal Commission, and twenty months after the most important bacteriological evidence had been given, stated that they could not regard this river as a suitable source of supply. The

Local Government Board had naturally in view the fact that a still purer source was available, and considering the uncertainties of filtration, concerning which, if time allowed, I could tell you some curious facts which have from time to time come under my notice—who shall say that they were wrong?

The authorities who desire guidance in such matters naturally watch the decisions of Royal Commissions; and in order that they may obtain sanction for the issue of loans they are often compelled to consider the decisions of the Local Government Board. In view of these facts as regards the country at large, and in view of the further delay of the remedy of the present evils as regards the Metropolis, I am impressed by the very unfortunate nature of the limitations of the reference to the Royal Commission and the interpretation that has been placed upon it.

The day is very far distant—if indeed it will ever come—when pure mountain water, taken virtually from above the limits of human habitation or drawn from perfectly safe sources underground, will be insufficient to supply the wants of this country; till then, is it wise to continue to invest our capital in, and to prolong the life of, undertakings which are dependent for their safety entirely upon the continuity and perfection of artificial processes of purification? In connection with the Thames and Lee supplies much has been said about the "sentimental objection." The term may be one of opprobrium, or it may not, but it is certainly a very real objection. It is an objection which I do not think will be removed by any discoveries, as to the wonderful efficacy of microbes lying in a thin film—mud enwrapt, in dead or living myriads—over the surface of our filter beds, to prevent the passage of on-coming bacilli.

The idea of drinking water with such antecedents as that of the Thames and Lee, can never fail to be repugnant to many persons, and at present we are certainly not in a position to assure those persons that their objection is quite groundless.

But I have too long occupied your thoughts with the consideration of certain things that have been, and of other things that might have been. It is no small satisfaction to me to feel that we are now about to discuss practical things of the present and their relation to the future health and prosperity of the great nation to which we belong, and thus in due course, to improve the well being of mankind.

SECTION III.

CHEMISTRY, METEOROLOGY, AND GEOLOGY.

ADDRESS,

BY THOMAS STEVENSON, M.D., F.R.C.P.,
(MEMBER).
PRESIDENT OF THE SECTION.

DURING the last ten years, perhaps no subject has received greater attention from chemists, biologists, and sanitarians, than that of what was formerly termed the self-purification of water, the manner in which, and the natural agencies by which, this process of purification is effected. Gradually during the last twelve or fifteen years the views of most of us have undergone a great change; and many of those who formerly held the view that a river once polluted with sewage is incapable of self-purification, and that even when filtered the water is still unpotable, now hold that by sedimentation and filtration such a water is effectually purified and freed from all noxious constituents. Happily, those who administer the municipal affairs of the great city in which we meet took, before the revolution in views which I have indicated, the wise and proper course of securing a water supply from unpolluted sources, and obtained a water presumptively free from all danger to public health by organic pollution.

As might be expected, experimental researches carried out on new lines, and aided by the light afforded by many scientific fields, have led to novel discoveries; and all along the line our knowledge of the agencies at work in water supplies has increased; benefit has undoubtedly accrued to public health, and still greater benefits may be expected to be reaped in the near future.

The time must be within the memory of almost the youngest here present when a great, prolonged, heated, and for a long time quite indecisive controversy raged among chemists as to whether or not a water once contaminated could by prolonged exposure to the atmosphere ever recover its original organic purity, or even whether it could do so by any process short of distillation and reprecipitation, either artificially carried out, or naturally by means of vaporisation by the sun's heat and subsequent condensation into rain-water. It was further held by some that soil-filtration, except where percolation took place through great depths of soil, was inadequate to purify a polluted water so as to render it safe and potable. On the other hand, there were those who did not accept this pessimistic view, but without bringing forward conclusive scientific evidence of their more optimistic views. Facts were adduced by the holders of these discordant opinions in support of their respective contentions. On the one hand, the obvious disappearance of the grosser forms of sewage matter when turned into a stream, and within a comparatively short distance of their inflow, was a fact patent to every observer. A stream black, befouled, and repulsive to the senses of sight and smell, within a few miles—and often within a far shorter distance—was known to lose all evidence to sight and smell of its antecedent pollution. To all appearance every trace of contamination has disappeared. As against this were opposed the facts that a water purposely contaminated with sewage may be exposed in the laboratory to air, and may be agitated therewith, and yet persistently retain nitrogenous organic matter, refuse to nitrify, and at a certain stage refuse with the greatest pertinacity, to part with more organic matter. Even sea-water has been found to contain organic matter of a highly nitrogenous character; and sea-water is river-water, in many cases antecedently polluted, which has undergone a maximum of exposure to aërial influences. Organic matter in water was taken to be presumptive evidence of the unsafeness of this for drinking purposes; and water which contained an excess of organic matter, or which by its abundant yield of nitrates, showed evidence of previous sewage contamination, as it was called were, illogically perhaps, but for the most part with manifest advantage to the public health, was unhesitatingly condemned as a drinking supply.

It was admitted that the free oxygen in a water would, up to a certain point, effect the oxidation of organic material; but the process was admittedly a slow one. A further destruction of organic matter was known to be effected by the ravages of aquatic animals; but how far these themselves, by their living and excretory processes, contribute to undo what they had otherwise done as feeders on filth, is unknown. Again, it was supposed by some that aquatic plants served to effect purification, though the living actions of green plants involve processes of reduction rather than oxidation of organic matters. The effects of sedimentation are here excluded from consideration, as it was then as now considered to be a step only towards effective purification.

But this vain and unprofitable warfare was not to continue. Some dozen years ago light began to dawn on the minds of those who had habitually to consider these questions, and it was seen that the problem must be attacked on new lines if it were ever to be settled; and this new attitude of mind towards the question was guardedly referred to in 1884 in the Final Report of the Royal Commission on Metropolitan Sewage Discharge, of which Commission I was a member, where it was said:—"But the *rationale* of these processes (precipitation processes) has apparently been but little recognised, and, indeed, it is only within the last few years that scientific knowledge has sufficiently advanced to enable us to understand the matter. There are two chief methods by which effete organic materials, such as excreta, are got rid of, namely, by fermentation and by oxidation. Nature, in this climate at all events, utilises both these processes, and in the above order. The organic molecules of effete matters are first split up by fermentation (and putrefaction is one kind of fermentation) into less complex substances, often of an offensive character, and these are subsequently oxidised into inodorous inorganic substances. The agents by which these fermentations are brought about are those microscopic organisms known as *bacteria*, which either themselves set up fermentation or excrete substances which act as ferments. Bacteria, or their spores, are present everywhere, and, gaining access to sewage, set up fermentation."

It must be remembered that this was written ten years ago; but, nevertheless, it represents a great advance on the opinions held ten years antecedently, although it is only a foreshadowing of what could or would be written now under similar circumstances.

If these statements are compared with those put before the late Royal Commission on Metropolitan Water Supply, the advance in knowledge during the intervening nine years is well seen. During the last nine years advances in our knowledge have been very great, and although there is a great conflict of evidence between bacteriologists, and the science of bacteriology is still in its infancy, we now know much more of the life-history, the functions, and the effects of bacteria, and the chemical processes associated with them, than we then did. The fact is accepted by all, that bacteria are among the main agents in effecting the purification of water, as well as in inducing infectious diseases, such as typhoid fever and cholera. And, indeed, although the bacteria which produce summer diarrhœa and many other diseases, have not with certainty been isolated and recognised that such diseases are induced through the agency of micro-organisms is a part of the current creed of scientists.

We have to look upon micro-organisms in water as of at least two kinds, (1) the pathogenic or disease producing organisms, (2) the beneficent or purifying organisms; to which may perhaps be added a third kind, the inert organisms—inert, as neither producing definite disease, nor, perhaps, acting as purifying agents. Whether we recognise a two-fold or a three-fold division, the importance of discriminating between pathogenic and non-pathogenic organisms in water is all important to the physician, and, happily, new appliances and new methods have done much in this respect, and knowledge is advancing with rapid strides.

Pathogenic bacteria appear, as a rule, to produce their specific effects through the agency of the products of their living processes or excreta. But though ptomaines, toxines—alkaloidal or other products—act as poisons, such chemical entities as I have referred to have as yet almost never been demonstrated in the drinking water of rivers. It may be that in some cases the introduction of the bacteria into the human body alone directly induces the mischief, or it may be that the excretory products introduced with them act as poisons. We cannot as yet dogmatise as to this.

In the human organism, provided the conditions are favourable, the bacteria grow, multiply, and generate those poisonous chemical products of their activities which produce disease. A few germs introduced into the body quickly become incredibly multitudinous, the toxines proportionally increase in amount, and circulating in the blood, toxic effects are manifested. Hence the importance of preserving our water-courses from specific contamination, and the equal importance of securing their purification, when polluted, by placing them under such conditions that the pathogenic bacteria may be starved, killed, or destroyed and consumed by beneficient micro-organisms.

We are almost entirely in the dark as to how far and what kinds of pathogenic bacteria are destroyed by the non-pathogenic. One assumption by the Royal Commission on Metropolitan Water Supply is supported by slender evidence. It may be true, as stated by the Commissioners, that it is the generally accepted doctrine of bacteriologists, that the pathogenic organisms and the ordinary river bacteria to which the decomposition of organic matter is due are naturally antagonistic; but antagonism has rarely been proved to exist between such organisms. Such antagonism has been proved to exist only between a very few organisms, and never between ordinary river bacteria and the typhoid bacillus. Although experimenters for the most part agree that the bacilli of typhoid can be found at a much later date in sterilised than in unsterilised water, this is not conclusive as to the antagonism of the pathogenic and non-pathogenic organisms.

In considering the degree of safety conferred upon a water polluted with sewage by the natural processes going on in streams, we have to weigh the results brought about by sedimentation, disintegration, solution, oxygenation, dilution, light, and by the living processes of vegetable and animal organisms contained in the water. A few only of these agencies can now be reviewed; but the question may be considered, how far do those agencies, separately and in combination, bring about the destruction of noxious matter? This is the point of chief interest to us as sanitarians and to the public. In what I am about to say I feel that there are wide lacunæ in our scientific knowledge, how dimly we grope at precision where no precision is at present attainable, and what a vast field lies open to future research.

Sedimentation is a very important factor in the purification of river water. The amount of suspended and even dissolved organic material carried down by the deposition of finely divided clay and other aluminous and calcareous matter, either accidentally present or artificially introduced into a water, is relatively enormous. In the deposition of sediment countless bacteria are entangled, carried down, and doubtless perish in the end, by the action of light, the suspension of their activities, and the withdrawal of the conditions necessary for their growth and multiplication. Assuredly, sedimentation is one of the great beneficent agents increasingly at work in purifying our water supplies. Its value cannot be over-rated; but it must be admitted that it is not altogether effective.

The experiments of Professors Percy Frankland and Ray Lankester show that by sedimentation it is possible to remove all the bacteria from a water. This can, however, occur only under exceptionally favourable conditions, and it is agreed that the process cannot be exclusively relied upon, and that it needs to be supplemented by other means of purification.

When bacteria are separated from a water by deposition in the mud, we cannot be sure that they may not be capable of revivification and multiplication, when the mud is disturbed as in times of flood. But it is not likely that they are capable of retaining their potentiality for evil for an indefinite period; yet the fifteen days assigned as the limit of activity for the typhoid bacillus rests on no sufficiently assured basis.

How far simple oxygenation of a water is capable of destroying organic matter and living organisms is undetermined. As we all know, water is capable of taking up from the atmosphere nearly two cubic inches, or about half a grain of oxygen, per gallon of water; and when this gas is withdrawn or consumed in the oxidation of organic matter present in the water, a further supply of oxygen is quickly absorbed from the air. Hence the degree of aëration of a water was proposed and used to ascertain the purity of river waters. If aëration was found to be fairly complete, it was assumed that organic matters were fairly well oxidised, and presumptively rendered inert; whilst on the other hand, a deficiency of free oxygen in a water, indicated that processes of oxidation were still going on and hence that decomposable organic matter was still present. Setting aside the difficulty of ascertaining by analysis the amount of free oxygen actually present at any given moment in a river, the test is an inadequate one. It is probable that it is not chiefly the inert ordinary free oxygen that is the active agent in effecting oxidation of organic matter. Rather, the evidence tends to show that it is the more active form of oxygen, ozone, and still more the hydrogen dioxide formed during many chemical changes going on around us, that are the effective oxygenants. Yet all agencies which tend to aërate a water, tend also to introduce ozone, hydrogen dioxide, or whatever be the efficient oxidiser, into the water.

Agitation and free exposure of as large a surface of the water as possible to the atmosphere are most effective in bringing about water purification.

Among the other agents of purification is disintegration, which is doubtless an important factor, dead and torpid organisms undergoing in sediment a slow or rapid disintegration and destruction. But the effects of disturbance, as by floods, must not be lost sight of, for by disturbance bacteria may again be set afloat in a stream, and meeting with the necessary conditions and the pabulum for their growth, may grow and multiply afresh.

Disintegration leads to solution, and solution to dilution, and as it is undeniable that the dose of a poison may be so far reduced as to render it inactive or non-toxic, the products of bacterial life, and the products of bacterial decay, may be so far diluted as to render them practically inert.

But it is to the bacteria, not to speak of the other and higher organisms in water, that is to be attributed the chief effect in the purification process. Beneficent and pathogenic bacteria live and have their being in impure water, break up and appropriate the nutritive material contained therein, and carry on their life-processes either amicably side by side, or are mutually destructive of one another. Doubtless, too, they secrete material, which, at all events, in the case of the pathogenic bacteria, is noxious. How far noxious, we know not. The excretory products of bacteria are generally destructive to other species.

And here I may parenthetically remark that we do not know the amount and kind of animal excreta contributed to our water supplies by the animal life inhabiting them. Excretory matter there must be, *e.g.*, that of fishes; but Sir William Roberts informs me that we are entirely ignorant of the composition of the liquid excreta of fishes. Their excreta in the normal condition are probably fairly inert when present in water; but the kind and nature of the organic matters present in river water must in some degree be dependent on the animal life present in the stream.

To return to what I was saying about bacteria. The danger of pathogenic bacteria in water depends, I believe, on the liability of the organisms themselves to be ingested by the human being, and not to any material extent upon the ingestion of toxines or other chemical substances, the products of bacterial action, in the water. Hence the importance of depriving a water as far as possible of all bacteria, whether pathogenic or non-pathogenic, before utilization for drinking purposes. Bacteriological examination is sometimes inconclusive, and we can only judge of the safety of a water by its obvious freedom from bacteria of all and every kind. At present bacteriologists have gone a little and not much further, except in some special cases, than the counting of bacteria, or of colonies of these; but we may hope that at no distant date something more will be done, and that with improved and easier modes of recognition, pathogenic will be readily distinguished from non-pathogenic forms in a water, to the great advantage of the public health.

Not the least interesting of the processes going on in running water is that brought about by light, an agent very potent in destroying or benumbing the activities of pathogenic bacteria. As Professor Percy Frankland has pointed out, in his work on micro-organisms in water, to Downes and Blunt belongs the credit of having, seventeen years ago, not only first demonstrated the bactericidal effects of light, but in having at once so perfectly indicated almost all the factors connected with this action, that the further investigations which have been carried out on this subject during the intervening years, have been little more than confirmations or additions of detail to their work. Undoubtedly bright sunlight acts deleteriously on bacteria, especially in the vegetative forms as distinguished from their spores, and this independently of the direct rise of temperature due to exposure to the sun's rays; air and moisture being important adjuncts to light. The formation of hydrogen dioxide during insolation may be contributory to the bactericidal effects, and must aid oxidation. But unfortunately, notwithstanding the researches of Marshall Ward, we know too little of the effects of the dim and diffused light which alone can penetrate through considerable depths of water. Further experimental observation is needed with various pathogenic bacteria as to the effects of dim light as a bactericidal agent, and also as an attenuator of the activities of bacteria without destroying them. I myself am inclined to think that some able experimenters are too sanguine as to the speedy destructive effects of light on micro-organisms; nor would I venture to do what one distinguished bacteriologist no long time ago expressed to me his willingness to do—viz., to drink without fear water known to be infected with typhoid bacteria, provided that after infection, and before drinking it, the water had been freely exposed to light in an uncovered cistern for three or four hours.

Filtration is the last and most important resort which must be had recourse to for the purification of our water-supplies. The mechanism, if I may use the term, and the results of sand-filtration have received within the last few years the greatest attention at the hands of scientific observers and sanitarians. We now know—dimly and imperfectly, it is true—how filter-beds act; and the results once attributed to mechanical effects or to chemical action are now known to involve a biological factor. Briefly, a filter-bed, when effective, has become covered with a gelatinous, colloidal mass of bacteria, and this living area has the power of arresting 97·5 per cent., or more, of the bacteria in the filtering water. It is not that the micro-organisms, are not small enough to penetrate the interstices of the filtering area; but somehow, be they large or be they small, micro-organisms are for the most part arrested, dissolved, disintegrated, consumed, or, it may be, poisoned by the excretions of the zoogl\u0153a mass of which the filtering area is composed. At all events, whatever be the exact nature of their action, a water teeming with bacteria, like the unfiltered water of the Thames, issues on the lower surface of the filter-bed containing on an average only 29 organisms per cubic centimetre. Indeed, so great is the diminution in the number of micro-organisms brought about by ordinary sand filtration that some persons are, as I believe rashly, disposed to think that sedimentation in reservoirs, supplemented by sand filtration, is all that is necessary to render our polluted water supplies safe and potable. But when we reflect that the two, three or four per cent. of escaping bacteria still form a huge number in the aggregate (29 per cubic centimetre represents 4120 bacteria per half pint of water—an ordinary glassful), and these may quickly multiply, our assurance of the safety of such water can only be relative. The fact that typhoid bacilli have never been detected in filtered Thames water is not conclusive as to these being altogether stopped by the filters, for these bacteria have never perhaps been detected in ordinary unfiltered Thames water. And seeing that on an average one typhoid stool in the Thames is diluted, according to the Commissioners, with 294 million gallons of river water, and further that on an average 97 per cent. of the bacteria are removed by filtration—not to speak of other agencies—the probability of the detection of typhoid bacilli in the filtered water is very remote. All that we can say is this that they can be but few in number.

The test of the strength of a chain lies in its weakest link. When we look at filters from a practical point of view, we see how many feeble links there are: cracking of the gelatinous surface of the filters: the formation of chinks and runlets in them, as is the case with all colloidal filtering masses; the overtaxing of the filters; all these are elements of danger. Speaking from daily personal observation of the filtered water supplies of two of the London Companies, I can testify that in the autumn and winter months these filtered waters are frequently slightly turbid, coloured, and uninviting in aspect when viewed in large masses. How far they are injurious to those who drink them it is difficult to say. Indeed no very obvious results ensue from the drinking of them, though one might perhaps anticipate results were the Thames at any time to receive a large access of cholera stools.

What, then, are the conclusions to be drawn from recent advances in our knowledge of river pollution and river purification? What practical inferences are to be drawn? What suggestions are to be made as to lines of future action?

The notion that organic matter in a water is *per se* to be regarded as injurious must be laid aside. The potable quality of a water must not be judged by the mere quantity of organic matter therein. Organic matter, and especially nitrogenous organic matter, must, however, be regarded with suspicion, and the presence of an unusual amount of it ought invariably to call for the rejection of such water as a source of drinking supply and the results of chemical analysis must in no case be set aside as altogether illusory.

Next, the necessity of guarding our rivers from all unavoidable pollution and especially excremental pollution, is rather emphasized than diminished, although practically we have been unable to distinctly connect disease in the metropolis with Thames water-drinking, there is no small likelihood of there being an undiscovered connection between the two. The statistical evidence is vague, incomplete, and inconclusive, and does not enable us to say yea or nay to the proposition. With the evidence of the Tees Valley outbreak of typhoid fever before us, and the break down of all attempts to discredit the connection between the Tees Valley supply and that epidemic, we must hesitate to adopt the proposition that typhoid bacteria have but a very limited term of existence outside the body, that they speedily die or become incapable of resuming their pathogenic properties, and that they are unable to survive exposure to a limited amount of light and air, or even that they necessarily speedily become the prey of other bacterial organisms.

We must admit that light, air, agitation, precipitation, subsidence, and, above all, filtration, can do much in the way of purification; and that under favourable conditions these purifying agencies can and often do render a polluted water safely potable. But there is a danger in trusting too much to these in leading us to neglect the urgent necessity which everywhere exists of protecting our water supplies from pollution. Surely the need to protect our rivers from pollution was never greater than at the present time. The wisdom of large communities, such as those of Liverpool, Manchester, and many others, in securing water from unpolluted sources cannot be questioned. Unfortunately, the large sources of mountain supply are rapidly becoming appropriated by towns to which a water of rare purity and great softness is a primary need for its manufactures; not to speak of health requirements. We who live in London lack that public spirit which guides such municipalities as that of Liverpool. There is a tendency to regard our metropolitan water-supplies as in no danger of failing in either quantity or quality. A selfish section of the community still regards the Thames merely as a means of securing its own pleasure. At no time has there been greater need of pecautions being taken to secure the Thames from human excremental pollution than at present, when the floating population in summer is so enormous, and where the introduction of fresh human excreta all along the river is a matter of almost complete certainty. You, in this great city, run no such risk, and are happy in the possession of that best help to a healthy life—a pure drinking water.

CONFERENCE ON THE SANITATION OF THE PASSENGER AND MERCANTILE MARINE SERVICE.

ADDRESS

By Sir WILLIAM B. FORWOOD, J.P.,

PRESIDENT OF THE CONFERENCE.

The Council of the Sanitary Science Congress have very appropriately decided that special attention shall be directed at this meeting to the sanitation of the ships of the mercantile marine, recognising that in the Port of Liverpool the great stream of emigration which flows towards the United States has its origin, and therefore that a conference on this subject, while it will throw light upon the sanitary conditions which at present prevail, may also lead to suggestions which may tend to their further improvement.

In discussing the question of sanitation on ship board, we must not forget that the conditions of sea-life differ greatly from those of shore-life. On shore three great physical essentials to sanitation, good drainage, pure water, and fresh air, are secured generally only imperfectly and frequently with great difficulty, and even when secured their value is too often destroyed by the dirty, thriftless habits of the people; at sea these three great essentials to health can be obtained without difficulty, and the seaman and the emigrant being under command, their proper use can be secured without fail.

We can only compare a ship at sea to a shore institution surrounded by a perfect system of drainage, with an abundant supply of good water, and situated on the hillside, open to all the winds of heaven, with the inmates under perfect discipline. It seems strange that with such conditions the question of the sanitation of our ships need be discussed, yet it is not many years since the forecastles of many of our merchant ships were a disgrace to our civilization. Situated right in the bows of the ship, often not more than 4 feet 6 inches to 5 feet in height, cumbered up with the windlass, chain cables and hawsers, flooded with water, which rushed through the hawse pipes every time the ship plunged into the sea. Destitute of sanitary conveniences of any kind, and filled with the hot steamy atmosphere of bad tobacco and damp drying clothes, for which there was no escape, as there was no ventilation whatever; no wonder that existence in such dens degraded the life of a seaman, and its baneful effects are still felt.

In many modern ships the crews are comfortably quartered in a deck house, where they can keep dry and warm, and sanitary arrangements are provided in the shape of closets and wash-basins, and in some ships baths are also to be found; while the food of the sailor is no longer the dull attenuating monotony of salt pork and pea soup and salt beef and plum duff; in well-owned ships he is well fed with a generous allowance of fresh meat and vegetables.

The condition of emigrant life on board one of the old fashioned sailing ships also left much to be desired; huddled together as closely as they could be packed in steerages rarely over 6 feet 6 inches in length, generally less, with only such light and ventilation as the narrow confined hatchways would afford, and at night lit only by a few miserable oil lamps which served only to make darkness more visible. On deck there was an absence of all shelter, and in bad weather the emigrant had only the choice of being drenched by the seas as they swept the deck, or to be poisoned by the pestilential atmosphere of the 'tween decks; the food supplied was of the scantiest description, inferior in quality, and badly cooked. To-day an emigrant in one of our great Atlantic steamers makes the voyage under sanitary conditions greatly superior to those he enjoys in his own home; the steerages are lofty and well ventilated by movable cowls and electric fans; and abundantly lighted by large side ports by day, and by the electric light by night; the beds and bedding are scrupulously clean, the bedding is supplied by the shipowner and is never used for a second voyage; ample seat and table accommodation for meals is provided, and each compartment is furnished with a pantry and hot and cold water under the care of a special attendant; on deck a spacious promenade is available to the emigrant under a shelter deck where he can take exercise in all weathers; the sanitary arrangements are excellent; and his food is well cooked and without stint as to quantity, for his mid-day meal he has always soup, fresh meat and potatoes.

Every morning, after breakfast, the emigrants are all sent on deck, while the steerage is thoroughly cleansed and ventilated; and the Captain and Doctor at this hour make a personal inspection to see that everything is sweet and clean. I have been present at many of these inspections, and have been much struck with the cleanliness which prevails, and with the purity of the atmosphere.

The ship Doctor has ample hospital accommodation at his command, and is furnished with a complete dispensary and surgery.

The sanitary condition of our emigrant ship very greatly depends upon the strict observance of the rules as to cleanliness and ventilation; for this the Captain and Doctor are primarily responsible, and I attach the greatest value to the daily inspection made by these officers.

It was my fate to make a voyage in an emigrant ship to Australia thirty-five years ago. I frequently cross the Atlantic, and I can assure you that I have not overdrawn these descriptions.

How has this great change, this vast improvement, been brought about? In the first place, it is due to the substitution of steamers for sailing vessels; to their increased size; to competition; and lastly, to the more stringent Board of Trade regulations. The influence of the regulations of the Board of Trade I put last, because, except in regard to the deck space allotted to each emigrant in the steerage, the arrangements made by shipowners are a long way ahead of the Board of Trade requirements; and in regard to the size of the steerages and their capacity to accommodate emigrants, the Board of Trade regulations are often arbitrary, failing to take into account the large air space and ventilation afforded by lofty 'tween decks, improved means of ventilation, and making no distinction between a vessel crossing the cool latitudes of the Atlantic, and those traversing the tropical climates of the Red Sea and Indian Ocean. In this way shipowners are considerably handicapped in the keen competition waged by foreign steamers.

The question which you will now expect me to answer is, in what way can the sanitation of the mercantile mariner be improved? I do not say it is not possible to further improve the sanitary conditions; reducing the number of emigrants would give more air space, but it is not required for health; and in these matters we must above all things be practical, and have reference to the conditions and circumstances of the trade, and so long as the State makes such regulations as will secure the health and safety of the emigrant, all else may be safely left to the effect of competition. State regulations must be always arbitary, and tend rather to check than promote improvements. I confess I am unable to suggest any practicable improvement in the sanitation which prevails in our more modern Atlantic liners. It seems to me that the emigrant travels at sea under conditions vastly superior to those available to him on shore, or which ordinarily surround his own home. Of course, all steamers do not offer these conditions, but competition must raise the general standard to that of the best.

The science of ventilation is being better understood every day, but it is still far from being perfect, and in this direction we may hope for further improvement. In the accommodation usually given to seamen there is still often an absence of sanitary conditions. Here competition does not come in, and the indifference and greed of the shipowner is too often apparent. It would be very arbitrary to enforce a regulation prohibiting the use of the forecastles, because they can be made comfortable, though they are not always so, and their ventilation must always be difficult, and greater privacy ought to be given to a sailor than is possible in an open forecastle.

I know the tendency in these days is to ask for state interference and regulation in all the affairs of life. I am strongly of opinion that this is being pushed to a mischievous extent; it has a paralyzing influence, and destroys personal responsibility, and beyond laying down regulations necessary for the safety of life and promotion of health, all else may and should be left to the shipowner, who is keen enough in his own interest to see that life on board his ship is not only healthy but so comfortable as to secure for his ship a good name and reputation.

CONFERENCE OF MEDICAL OFFICERS OF HEALTH.

ADDRESS

By CHARLES E. PAGET
(Fellow.)

PRESIDENT OF THE CONFERENCE.

SOME IMPERFECTIONS OF PUBLIC HEALTH ADMINISTRATION.

Introductory.

When, to my surprise, the Council of The Sanitary Institute invited me to act as President of this Conference of Medical Officers of Health, I naturally felt some diffidence about accepting that honour. The necessity for an opening address was not the greatest cause of my hesitancy. I could not but recognise the fact that there were others far better fitted than myself to perform the duties of the office. Having, however, acceded to the request of the Council of the Institute, I take this opportunity of expressing my hearty thanks to it, not merely for the honour which it has done me, but for that also, and especially, which it has done to the Borough that it is my fortune to serve.

The time and the place in which we meet have led me to think of the past, and the future prospects, of the public health medical service of this country. We, at least, may be proud of the achievements of the past; we may glory, too, in the legacies of work well done which have been left us to cherish and to add to. But can we feel well pleased with the present prospects of those who are to follow us? Can we, without much reserve, say that the results of the labours of Medical Officers of Health are, outside the immediate sphere of their local work, either largely utilised by, or of more than very moderate usefulness to, the nation?

The time and the place impel me to review these questions. The time does so, inasmuch as we are rapidly nearing the close of that century within which the whole history of active and systematised sanitary effort is comprised; the place, because it was in this City that, owing to the wisdom of its governing body, the first Medical Officer of Health in this country was appointed.

First, then, Liverpool in 1847, and the City of London in 1848, set the example to the country of appointing skilled medical advisers for the purpose of dealing seriously and scientifically with the conditions inimical to health within their boundaries. Their example was followed by such cities and towns as Bristol, Cardiff, Leeds, Leicester, Manchester, Salford, Dublin, and Glasgow, as well as by others, down to the year 1872, when the appointment of Medical Officers of Health to all districts in England and Wales was made obligatory.

It is hardly to be wondered at, that, viewing the good which had resulted in such localities as had obtained the services of medical advisers, the Royal Sanitary Commissioners of 1869–71 should urge the universal appointment of Medical Officers of Health. It is still less to be wondered at that, as a result of their investigations, the Commissioners should declare the subject of effective sanitary local government to be one, the importance of which could not be too highly estimated. The Public Health Acts of 1872 and 1875, in large measure, gave practical expression to the observations of the Royal Commissioners. But they did not wholly secure effective sanitary local government. Other Acts have been passed since then for the extension of local government, but neither have these extended as fully as they ought to have effective sanitary administration.

I cannot but regard some of the imperfections of our public health administration, as far as the public health medical service is concerned, from two points of view, the one disclosing the spirit which has animated the medical profession, and the other that adopted by the legislature and the bureau, in meeting their responsibilities.

Recognition of duties by the medical profession.

In the early days of the appointment of Medical Officers of Health, especially before and immediately after the passing of the Public Health Act of 1872, it could not but be otherwise, in view of existing circumstances, than that only a small proportion of those then chosen from the ranks of the medical profession had any special knowledge of sanitary science or practice. The majority of the newly-appointed officers simply had to learn the nature of the duties that were required of them by the legislature. The success or failure of the intentions of the new Public Health Act virtually depended on the industry, tact, and intelligence of these gentlemen, and on their ability to secure the confidence of their various boards of administration.

It is now recognised, and history cannot properly ignore the fact, that no small portion of the whole number appointed proved equal to the task committed to them. In more than one part of the country, but more particularly in these northern counties, provincial officers, following the example set by their metropolitan brethren, banded themselves together into Associations for the purposes of inter-communication and mutual assistance in their labours. Hence the foundation of our Incorporated Society of Medical Officers of Health, and that unbroken brotherhood which has fortunately so far distinguished the body of health officers.

But it was obvious from the first that if for political, social, or personal reasons the average medical man was most likely to obtain the official posts thus created by the Act of 1872; if the growing interests of sanitary administration were to be protected; and if, therefore, the aim of the country should be to draw from the ranks of the medical profession, as its sanitary advisers, those only who were willing to fit and train themselves for such high calling, some steps would have to be taken. It was plain that a knowledge of hygiene, and possibly qualification therein, would sooner or later have to be made an essential condition of candidature for office. It was equally obvious, in the absence of a restrictive qualification, that, for the general welfare of the country, the teaching of elementary hygiene should form a part of the ordinary curriculum of the medical schools. These things were, however, felt and debated much more by the respected leaders of our profession than by the public. The traditions of medicine were worthily added to by the insistence of the leading medical schools, and examinations in Sanitary Science or State Medicine were speedily instituted. I believe that the University of Dublin even held its first examinations in 1871, before the passing of the Act which made the appointment of Medical Officers of Health obligatory in England and Wales. In 1875, however, the Universities of Cambridge and Edinburgh followed suit, and the recognition of the wisdom of their step was general throughout the profession. Let it, therefore, be clearly understood and remembered that this additional impost on medical education was made for the welfare of the country, and to the honour of our profession,—voluntarily and from high motive, not by legislative decree or in deference to popular demand.

Legislative recognition of public health diplomas.

From 1871 to 1888 inclusive, nearly 400 legally qualified medical practitioners had of their own accord secured diplomas in public health after proper examination. Then, and not till then, did the legislature show, by enactment, appreciation of what the Universities and Medical Licensing Bodies had foreseen was necessary, and require, though only to a limited extent, evidence of proficiency in health officers. I refer, of course, to Section 18 of the Local Government (England and Wales) Act of 1888,* which still leaves districts and combinations of districts, having less than 50,000 inhabitants, free to appoint as medical officers of health those who have not given special evidence of sanitary knowledge. In the meantime, the General Medical Council, acting under the powers conferred on it by statute, has imperatively insisted on more than one occasion upon increased stringency in the preparation by, and examination of, qualified medical practitioners for diplomas in public health. The last regulations of the Council † are not in themselves either unjust or unreasonable; but, regarded in conjunction with Section 18 of the Local Government Act of 1888, a situation is disclosed which constitutes a most serious defect in the sanitary administration of this country. The defect is indeed an injustice to intending medical officers of health.

Uncertain value of public health diplomas.

Put shortly, it amounts to this. In large districts only are diplomates, or others specially qualified in public health, eligible for appointment. This, however, was the pretty general practice before the passing of the Act of 1888. Therefore, the worth of the diploma was not materially altered in that respect by the passing of the Act. But, the diploma having been recognised by statute as specially qualifying for public health appointments, an expectation has not unnaturally been created in the minds of intending candidates that the diploma would prove valuable in competitions for districts having less than 50,000 inhabitants. No doubt, to a moderate, but only a moderate, extent this expectation has been realised. In very many cases, however, its value has not proved sufficient to outweigh local, political, social, or personal considerations. And yet, with the present extremely limited advantage of the diploma, fully qualified medical men are being led to spend at least a year of additional study, at much expense of time and money, while the bulk of districts are not required to appoint specially qualified health officers. This appears to me to be a grave injustice. The number of the larger appointments which fall vacant year by year is nothing like enough to justify the rush for health diplomas that is going on, if we may read the endeavours to obtain these diplomas as anything like an index of the numbers who are willing to take public health appointments.

---

* See Note A. † See Note B.

On the other hand, there would be no loss of value to the diploma, and it would be mere justice to the candidates for it, if the approximate number of appointments were knowable for which it would be required outside legal requirements. In that case, medical men would then qualify for the ranks of the public health medical service with their eyes open at any rate as much as are those of military men who seek to qualify themselves for staff-appointments.

Increased value of diplomas is desirable in public interests.

If, then, it be desirable in the public interests to further encourage a high standard among officers of the public health medical service, the number of appointments for which the diploma should be compulsory must be increased.

This could not, however, be satisfactorily brought about by a simple statutory enactment that every sanitary authority should appoint only a diplomate in public health as its Medical Officer of Health. The salaries in far too many districts are separately quite insufficient to maintain a single man independently of private practice, or to recompense him for the labour and expense of obtaining the qualification. For such districts, unless there were also fair prospects of general or consulting practice, there would be no candidates from outside, even if there were no specially qualified practitioners within them. In this consideration, let me recall to your minds a summary of some returns embodied in the address of the President of our Society of Medical Officers of Health in November last.* The returns were made in the year 1888, and showed that "as regards salaries, no less than nearly 900 of those officers who were not debarred from private practice received amounts varying downwards from £50 to (in ten instances) less than £5 per annum, 358 ranged between £50 and £100, 275 received from £100 to £200, and only 25 exceeded this amount." To oblige, therefore, districts such as the majority of these to appoint only diplomates in public health would not greatly benefit the band of diplomates, unless they were already in good practice within them.

Besides, the figures which I have quoted indicate a very serious defect in the public health administration of the country. We know how absurd it is to require of a general practitioner in fair practice, for the paltry sum of £20 or even £50 per annum, that he should keep constant supervision over notification returns of sickness from day to day, mortality statistics from week to week, regulate the work of inspectors of nuisances, and run the risk of offending his private patients by vigilance over their insanitary occupations or properties. The marvel, indeed, is that so much good local work, as has been, should have been done under such circumstances. It can only have been done at great sacrifice of personal interests.* But the legislature, if it takes count of these things, hesitates at large interference with local desires.

---

* Dr. W. T. G. Woodforde, on the Local Government Bill. *Public Health*, Vol. vi., pp. 67–70.

We are, of course, all perfectly aware that the spirit of local government is the main-spring of our national vigour; but this spirit is not necessarily antagonistic to the strengthening of national health administration. If it be good for purposes of national health that the prospective medical advisers of sanitary districts should be encouraged, at great personal pains and expense, to study hygiene profoundly,—and none who have intelligently watched the results of past appointments in large urban or combined districts will probably deny this good,—then the smaller districts of the country ought to be prepared to give that encouragement by combinations among themselves, and so put themselves in a position to secure the whole-time services of those medical men who are highly trained in public health. Combinations of districts may be made for the purpose of securing an independent officer of health, without occasioning any transference of district authority. The Boards of the several districts can carry on their business just the same; but they have the advantage of unbiassed official advice in common, instead of that which may be easily marred by conflicting interests. I speak feelingly on this matter, because my own experience during six years as the officer of such a combination of ten local authorities was particularly happy, both in respect of work accomplished and of official relations with all the local authorities. I was, and still am, deeply impressed with the great public advantages of combinations of small districts. And if, as I believe, local opinions are gradually becoming less averse to the conjoint appointment of a responsible health officer, then there should be less difficulty than there has hitherto been in the way of securing combinations for that purpose.

---

* I cannot forbear making the following quotation in connection with this subject:—"It would of course be unfit that the Officer should be collaterally engaged in any commerce which might probably render his official judgment less single-sighted, or his official activity less straightforward, than it ought to be; and presumably the duties of the office would not in general easily harmonise with the interests of a practitioner who should be having to earn the main part of his livelihood by ordinary private practice within the same area. It would also seem clear that Officerships of Health could hardly answer to the pretentions of their name, nor be of much real account in the service of the public, except in proportion as they were important items in the lives of those who held them; not in each case on so petty a scale as to involve mere driblets of occasional duty, but, on the contrary, on such a scale that each appointment, in regard of its work and remuneration, might satisfy, wholly or in considerable part, the claims of a moderate personal ambition." —*English Sanitary Institutions*, by Sir John Simon, K.C.B., p. 336.

How does the law then stand in this matter? Section 286, of the Public Health Act of 1875,* gives the Local Government Board powers to compulsorily combine districts for the purpose of appointing a medical officer of health, on a representation made to it, if it appears to that Board that such an appointment would diminish expense, or otherwise be for the advantage of those districts. The Section does not say from whom the representation may come; presumably it may come from anyone. To my mind, the weakness of this otherwise powerful section of the Act lies in this matter of a representation.

There is, of course, no difficulty when a certain number of authorities are willing to combine and make a joint representation. But if a representation were made by a single authority, without agreement between it and other authorities having been arrived at, bad feeling would naturally be engendered between it and its neighbours, even though the local advantages of combination might be most obvious. If an individual made a similar representation he could scarcely fail to cover himself with odium or ridicule, or both, according to his local status and influence. Again, a representation might, quite properly I imagine, be made by an Inspector of the Local Government Board who had been sent to enquire into and report upon the sanitary administration of one or more districts in a particular neighbourhood. No one having any good local influence would be likely to raise any serious protest to such a representation; but it is perfectly conceivable that the Local Government Board might greatly hesitate to take action thereon, lest by so doing the Board should be made to appear both arbitrary and inconsiderate of local feelings. It is also conceivable that the Board would not desire to act on the representation of a single authority or an individual, on the ground that the representation did not indicate such a proportion of local opinion as would justify an enforced combination or guarantee its satisfactory working. It thus appears to me that some other machinery than dilatory agreement between neighbouring authorities is necessary for the purpose of effecting combinations of districts. The machinery, however, must be more local than central if it is to be popular.

---

* See Note C.

An extension of sanitary administration was made possible, but not obligatory, by the Local Government Act of 1888. Under that Act, County Councils were established, and these Councils were entrusted with certain powers of sanitary supervision and control of districts within their counties. Those powers have, moreover, been added to by the passing of the Isolation Hospitals Act of 1893. Under Section 17 of the Local Government Act of 1888,* the Council of any County has the power to appoint a Medical Officer of Health, or more than one if it thinks fit, who shall not hold any other appointment or engage in private practice without express written consent of the Council. Further, the County Council and any District Council are entitled to arrange for the services of such officer being made available in such District, and the arrangement, when made and carried into effect, relieves the District from the necessity of appointing a Medical Officer of Health so long as it remains in force.

Now here we have a *voluntary* means in small counties of effective sanitary supervision by one officer; but, so far as I know, it has not been utilised. In the institution of County Councils themselves, however, we have the machinery for securing effective sanitary administration on a national rather than on a peddling scale. I can of course only suggest how this machinery might be set in motion. It would be presumptuous in me to do more, for the subject has its technical difficulties, and how to overcome these belongs more to the politician and the parliamentary draftsman than to a local official.

But I would venture to suggest that the means by which suitable areas for sanitary supervision by Medical Officers of Health, devoting the whole of their time to that work, may be found in some such scheme as is shadowed by the following provisions:—

1. That a minimum unit of population be determined on, the possession of which, according to the last published census for the time being, shall alone entitle any single sanitary district, on and after a date to be fixed by statute, to independently appoint a Medical Officer of Health.
2. That in respect of a district which shall be below the required standard of population, the Council of the County, within which it is situated, shall determine and arrange, with or without public enquiry as the law may require, in which way the greatest sanitary advantage may be obtained for it, either—

---

* See Note D.

(*a*) under the powers already conferred on County Councils by sub-section 2 of Section 17 of the Local Government Act of 1888, or,

(*b*) by means of its union with one or more other districts, not being a county borough, within the same county, for the purpose of appointing a Medical Officer of Health.

3. That in respect of a district having the required standard of population, but not able to pay a salary to its Medical Officer of Health, which in the opinion of the County Council is reasonably sufficient, under all local circumstances, to secure the undivided services of a Medical Officer of Health, it shall be in the power (or required) of the Council to enquire and determine how such district may be best served by its union with one or more districts of whatever size, not being a County Borough.
4. That the decision of a County Council to require any such union of districts be forthwith formally communicated under the seal of the Council to the Local Government Board, and that such formal communication do constitute a representation to the Board under Section 286 of the Public Health Act of 1875, in accordance with which section the Board shall thereupon act.

If some such scheme, as I have thus ventured to sketch, became statutory, an additional provision might then be reasonably added requiring that no medical officer should be thereafter appointed unless duly qualified in public health. I cannot but believe that, in some such way as this, the public health administration of the country would be greatly improved, mere local prejudices might be overcome by local influence for the general good, and the public health medical service would be composed of specially trained and approved officers.

But, apart altogether from the construction of such a scheme as this, the limit of population for which a specially qualified Medical Officer of Health should be required, may surely be lowered from what it is at present. It would appear to be more in the spirit of the Public Health Act of 1875 if the limit were reduced from 50,000 to 25,000 persons. Section 286 of that Act,* stipulates "that no urban district containing a population of twenty-five thousand and upwards or (in the case of a borough) having a separate court of quarter sessions shall be included in any union of districts," formed under that section, without its consent. This is tantamount to saying that a district having 25,000 inhabitants, or being a Quarter Sessions Borough, may be considered as a proper one to have a Medical Officer of Health to itself. In that case, it should be in a position to pay for the services of one, and that officer should in the future always be properly qualified in public health.

---

* See Note C.

Annual reports of Medical Officers of Health.

The time at my disposal will not permit me to do more than refer to one other of the imperfections of public health administration. But it is one in which many Medical Officers of Health have, and in which all ought to have, an interest. It is in connection with that which to many of us is the fatigue of our office—our Annual Reports.

We are required to compile them. We accordingly turn them out annually. Undoubtedly, they are of variable quality and interest. But in respect of those, for the compilation of which time and patience have been well-nigh exhausted, how disproportionate is their subsequent usefulness to the labour which was bestowed on them! This was not, however, the intended result of the suggestion of the Royal Sanitary Commissioners of 1869—71 that such reports should be required of Medical Officers of Health. They indeed put the matter quite plainly ". . . by the reports it"—that is, the Central Authority, —"will receive from the Medical Officers of Health throughout the country, from his own Medical Officer or Staff (fulfilling the duties of the Medical Officer of the Privy Council), from the Registrar General, and from other sources, the Central Authority will in the future possess, under its own hand, a mass of important information, which, however, will be comparatively useless, if not duly arranged and published with a view, not only to its appreciation by scientific men, but also for popular comprehension. We recommend that the New Statute should empower and require the Central Authority to take measures accordingly."* Moreover, in their general observations, the Commissioners laid particular stress on the advantages which would be derived from the collection, study, and elaboration of these local reports. But if the results of such study are not published, then that which is of general interest is practically lost to the public. It is with this aspect of the matter that I wish to deal.

It is not an easy thing for those who have not had to compile reports, such as we have to, year by year, to appreciate the large amount of labour and thought involved in the task. Some medical officers produce them with greater facility than others, and it may also be that others get through theirs in a more or less perfunctory fashion. But to all who conscientiously strive to make their reports useful and truthful, the task is a serious one, and few can meet their obligations in these respects without some interference with the ordinary course of their other duties. The importance of the reports is manifest. They are of course records of the mortality and sickness statistics, and enquiries made respecting them, for a period of twelve months. They also contain information as to the local administration of public health during the same period, both in ordinary circumstances and to meet special needs. The reports are, therefore, mainly local. But this fact is not antagonistic to the supposition that they may contain facts, figures, and observations, the knowledge and application of which may be of national interest or usefulness.

---

* Second Report of the Royal Sanitary Commission, Vol. I., 1871, p. 87.

Under the present arrangement, one copy of the report of the Medical Officer of Health is kept by himself, one by the Local Authority, one is sent to the County Council if the district be not a county-borough, and another is sent to the Local Government Board. This arrangement fulfils one of the intentions of the Royal Commissioners, and is undoubtedly loyally regarded by the Central Authority in one respect, inasmuch as the reports sent to it are read, filed for reference, and utilised as the basis of action by the Central Board against dilatory or negligent Local Sanitary Authorities. So far, so good. But the reports appear to be only utilised in the Central Office for central purposes of action and reference, and matters of general interest in them remain buried there from the public eye. A fair number of the reports may contain careful accounts of investigations into obscure occurrences of zymotic disease, of influences affecting the artisan classes under varying circumstances in the dwelling and the work-place, of admirable modifications in rural as well as urban districts of local sanitary administration, and of other matters of importance, as useful for the help and guidance of the whole body of Health Officers as for the education of the public. But these are not abstracted, arranged, and made available for general information by the Central Authority, as the Royal Commissioners recommended that they should be.

It is true that a very moderate proportion of the whole number of Sanitary Authorities in the country go to the expense of having the reports of their Medical Officers of Health printed. They are to be highly commended for so doing. But the majority of Rural Authorities, in whose districts investigations into isolated outbreaks of disease are usually quite as interesting as in large urban districts, do not print their Medical Officers'

Reports. Unless, therefore, those Medical Officers are good enough to go to the trouble of composing a further account of their investigations, for submission to one of our Societies or for insertion in the Medical Press, neither we nor others out of their districts have the chance of learning of or studying them. When the reports are printed they are not of course *published* by the Local Authority. A varying number of copies are issued for distribution to the members of the local governing body, to the local press, to prominent medical practitioners and persons of position in the district, and some complimentary copies to the compiler for his personal presentation. In this last way some of us are fortunate enough to learn what is being done in other districts of the country, and to obtain information respecting special outbreaks of disease and the measures adopted to deal with them. Some few of us are thus fortunate; but others, less so, are equally interested in obtaining that information, and they cannot even buy it.

My contention, therefore, is this, that inasmuch as the Central Authority is the single repository of *all* the health reports of the country, *i.e.*, England and Wales, it has the means in its possession for the publication, either annually or biennially, of a volume of useful abstracts from such of those reports as contain facts of value. Such a publication would be important in more ways than one. It would in the course of a few years become an invaluable index of enquiries into disease, and of local health administration under widely varying circumstances.* Those who desired to learn of these would then know where to look for them. The volume would be helpful to Medical Officers of Health in telling them of dangers experienced by other officers under particular conditions, and would thus warn them and assist them in forming their own judgments. It might even serve to stimulate Local Authorities by setting before them the examples of others. It certainly would be of national interest and usefulness.

---

* Within five months of his death in this year, Dr. S. W. North, one of the older Medical Officers of Health in the country—he was appointed for the City of York in March 1873—writing to me on this subject, said:—"For want of this information I have a firm conviction that not half the lessons which might be learnt from the recent epidemic of small-pox will ever become public property. I have come across during the past year a perfect legion of facts in connection with the administration of small-pox hospitals, and I feel that whenever I hand over my collection of reports to my successor, it will be too weighty a task to search out the hundreds of valuable papers which they contain, and which ought to rescue the writers from forgetfulness."

Much the same might be said also respecting the observations made last year in some, and possibly in many different, parts of the country as to the peculiar relation shown by Dr. Ballard to exist between the prevalence of summer diarrhœa and the temperature of the earth. It may be many years before we again have so prolonged a period of heat as was experienced in 1893, and so far we have had no assurance that we shall ever know either the extent to which such observations were made, or the value of the collected evidence.

But in addition to these major indications of value, we also may see in this small scheme an encouragement, such as has not yet been given, to some of the most patient and painstaking officers, whose labours indeed are barely known to some of us and are wholly unknown to many. It is likewise conceivable that it would act as a direct incentive to some other officers to aim at greater care in the preparation of their reports, and greater efforts to make them more generally useful. And these would be good results.

I cannot believe that the good which could be gained from such a publication as I have suggested will be denied. But I suppose that the excuse for not carrying out the suggestion may be made on the ground of the expense it would entail. Surely, however, the expense need not be a large one. If the reports are carefully read through and abstracted now for one purpose, other portions, which would be useful as general information, might also be marked off for abstraction and subsequent publication. Besides, the volume from the first would be a saleable one,—a good deal more so indeed than many of the blue-books which are published at the national expense. I cannot but believe, moreover, that if this small scheme were to be at all earnestly supported in influential quarters, the Treasury could with a little contrivance supply the means for its execution.

I cannot leave this subject without forestalling a question which may be asked by those who are not health officers. Are local health reports of much value for national purposes? The place in which we have met itself suggests an answer.

The impetus to permanent public health legislation in this country was supplied by members of our profession, in admirable reports on the gross unhealthiness of certain towns and districts, with an ability and courage of the highest order. Those reports contained illustrations of national needs. But they were distinctly local reports. I might quote the names of Drs. Southwood Smith, Neil Arnott, and others; but it is sufficient to speak here only of Dr. W. H. Duncan. He wrote a closely reasoned report on the physical causes of the high rate of mortality in Liverpool. This not merely led to his being appointed the first Medical Officer of Health in the country, but so deeply impressed the Commissioners, who were enquiring into the state of large towns and populous districts in England, that they printed it as part of their report in 1844. This report, when printed and published, served then, and was of value for, national purposes.

I may have chosen a monumental illustration, but it none the less indicates how in varying degrees selected portions of reports of Local Health Officers may, even in these later days, be also utilised for more than local needs.

Conclusion.

I have trespassed too long upon your time, and may do so no further. I have, however, but one word more to say.

The circumstances of the occasion have led me to address you on matters that have for some time past seemed to me to be imperfections in the public health administration of this country. But they specially recommended themselves to my mind for review because they appeared to be somewhat easy of correction. They may not be so. In any case they may continue to be unremedied. The continuance of the imperfections cannot, however, rob us of one of the chief stimuli of our aims,—the records of the labours of those who have gone before. What we cannot get altered, we must indeed abide by. But we may do something more than protest, and none can prevent us. We may so live up to those records of the past, that the work which we do shall make the imperfections of public health administration more and more glaringly manifest. Others, outside our profession, may thus be enabled to see them, and be led to insist on the necessity for amendment. When they do,—and they will not, as we, labour under the disadvantage of being directly interested parties,—then the form of health administration is more likely to be moulded to meet the ever present needs of the country, and to prove more beneficial to all whose health interests it is the duty of the legislature to enlarge. And so, though we indeed may fail to win reform, yet still we can pave the way for others to secure it.

NOTE A.

The Local Government (England and Wales) Act of 1888.

Section 18:—"Except where the Local Government Board, for reasons brought to their notice, may see fit in particular cases specially to allow, no person shall hereafter be appointed the medical officer of health of any county or county district, or combination of county districts, or the deputy of any such officer, unless he be legally qualified for the practice of medicine, surgery and midwifery.

"(2). No person shall after the first day of January one thousand eight hundred and ninety-two be appointed the medical officer of health of any county or of any such district or combination of districts, as contained, according to the last published census for the time being, a population of fifty thousand or more inhabitants, unless he is qualified as above-mentioned, and also either is registered in the medical register as the holder of a diploma in sanitary science, public health, or State medicine under section twenty-one of the Medical Act, 1886, or has been during three consecutive years preceding the year one thousand eight hundred and ninety-two a medical officer of a district or combination of districts, with a population according to the last published census of not less than twenty thousand, or has before the passing of this Act been for not less than three years a medical officer or inspector of the Local Government Board."

Note B.

Rules adopted by the Council on December 1st, 1893, for Diplomas in State Medicine.

To apply to those who begin the study of Sanitary Science after January 1st, 1894.

"I. The Council, having regard to the terms of Section 18 of the *Local Government Act* (1888), and observing that under that section special privilege is to be accorded to the holders of the Diplomas granted under Section 21 of the *Medical Act* (1886), and therein described as Diplomas in Sanitary Science, Public Health, or State Medicine, thinks it essential to declare, with regard to its own future action under Section 21 of the *Medical Act* (1886), that it will not consider Diplomas to 'deserve recognition in the *Medical Register*' unless they have been granted under such conditions of education and examination as to ensure (in the judgment of the Council) the possession of a distinctively high proficiency, scientific and practical, in all the branches of study which concern the Public Health; and the Council, in forming its judgment on the conditions of education and examination, will expect the following *Rules* to have been observed:—

"(1) A period of not less than twelve months shall elapse between the attainment of a registrable Qualification in Medicine, Surgery, and Midwifery, and the admission of the Candidate to any Examination or any part thereof for a Diploma in Sanitary Science, Public Health or State Medicine.

"(2) Every Candidate shall have produced evidence of having, after obtaining a registrable Qualification, attended during six months practical instruction in a Laboratory or Laboratories, British or Foreign, approved of by the Body granting the Qualification, in which Chemistry, Bacteriology, and the Pathology of the Diseases of Animals transmissible to Man are taught.

"(3) Every Candidate shall have produced evidence that, during a period of six months after obtaining a registrable Qualification, he has either practically studied the duties of outdoor sanitary work, under the Medical Officer of Health of a County or large Urban District, or else has himself held an appointment as Medical Officer of Health under conditions not requiring the possession of a Special

Sanitary Diploma. The Certificate of an Assistant Officer of Health of a County or a large Urban District may be accepted, provided the Medical Officer of Health of the County or District consents to the Assistant Officer giving such instruction.

"(4) Every Candidate shall have produced evidence that he has attended the Clinical practice of a Hospital for Infectious Diseases recognised by one of the Licensing Bodies; provided that such a course of instruction may have been taken as part of the Curriculum for his registrable Qualification in Medicine, Surgery, and Midwifery.

"(5) The Examination shall have been conducted by Examiners specially qualified; it shall have extended over not less than four days, one of which shall have been devoted to practical work in a Laboratory, and one to practical examination in, and reporting on, subjects which fall within the special outdoor duties of a Medical Officer of Health.

"⁂ The *Rules* as to study shall not apply to—

"(*a*) Medical Practitioners registered, or entitled to be registered, on or before January 1st, 1890.

"(*b*) Registered Medical Practitioners who have for a period of three years held the position of Medical Officer of Health of any County, or to any Urban District of more than 20,000 inhabitants, or to any entire Rural Sanitary District.

"II. These *Rules* shall apply to all Diplomas granted after January 1st, 1894, provided that the *Rules* passed by the Council on June 1st, 1889, and November 25th, 1890, shall continue to apply to Candidates who had commenced special study in Sanitary Science prior to January 1st, 1894.

"III. The Council shall appoint an Inspector or Inspectors of Examinations in Public Health, with special instructions to report to the Council whether the Examination of each Body does or does not give evidence on the part of Candidates passing such Examination of a distinctively high proficiency, scientific and practical, in each and all of the branches of study which concern Public Health."

NOTE C.

The Public Health Act of 1875.

Section 286:—"Where it appears to the Local Government Board, on any representation made to it that the appointment of a medical officer of health for two or more districts situated wholly or partially in the same county would diminish expense, or otherwise be for the advantage of such districts, the Local Government Board may by order unite such districts for the purpose of appointing a medical officer of health, and may make regulations as to the mode of his appointment and removal by representatives of the authorities of the constituent districts, and as to the meetings from time to time of such representatives, and the proportion in which the expenses of the appointment and of the salary and expenses of such officer are to be borne by such authorities, and as to any other matters (including the necessary expenses of such representatives) which, in the opinion of the said Board, require regulation for the purposes of this section; and no other medical officer of health shall be appointed for any constituent district, except as an assistant to the officer appointed for the united districts:

"Provided that no urban district containing a population of twenty-five thousand and upwards, or (in the case of a borough) having a separate court of quarter sessions, shall be included in any union of districts formed under this section without the consent of the local authority of such district or borough.

"Not less than twenty-eight days notice that it is proposed to make an order under this section, shall be given by the Local Government Board to the local authority of any district proposed to be included in the union, and if within twenty-one days after such notice has been given to any such authority they give notice to the Local Government Board, that they object to the proposal, the Local Government Board may include their district in the union by a provisional order but not otherwise.

"There may be assigned by the Local Government Board to the district medical officer of any union comprising or coincident with any constituent district, such duties in rendering local assistance to the medical officer of health appointed for the united districts as the said Board may think fit; and such district medical officer shall receive, in respect of any duties so assigned to him, such additional remuneration to be paid by the local authority or authorities of the district or districts within which his duties under this section are performed as those authorities may, with the approval of the Local Government Board, determine."

NOTE D.

The Local Government (England and Wales) Act of 1888.

Section 17:—" (1) The council of any county may, if they see fit, appoint and pay a medical officer of health, or medical officers of health, who shall not hold any other appointment or engage in private practice without express written consent of the council.

(2) The county council and any district council may from time to time make and carry into effect arrangements for rendering the services of such officer or officers regularly available in the district of the district council, on such terms as to the contribution by the district council to the salary of the medical officer, or otherwise, as may be agreed, and the medical officer shall have within such district all the powers and duties of a medical officer appointed by a district council.

(3) " So long as such an arrangement is in force, the obligation of the district council under the Public Health Act, 1875, to appoint a medical officer of health shall be deemed to be satisfied without the appointment of a separate medical officer."

CONFERENCE OF MUNICIPAL AND COUNTY ENGINEERS.

ADDRESS

By A. M. FOWLER, M.Inst.C.E.
(Member.)

PRESIDENT OF THE CONFERENCE.

Having been called upon to preside at this Conference of Municipal Officers, with whom I am professionally allied, I feel it incumbent upon me to refer to some, at least, of the questions which, in my opinion, call for the serious consideration of all whose duty it is to endeavour to improve the health and sanitary condition of the people.

The initial features standing out most prominently to my discernment are :—

1. The housing of the poor and working classes.
   The improvement in the condition of the dwellings, and the development of facilities to meet this end.
2. The improvement in the surfaces of the streets and ground in our midst.
3. The water supply for domestic use.

With regard to the first of these essentials I am of opinion that it is futile to endeavour to gain—or, shall I say mature—a condition of hygiene in the absence of satisfactory dwellings being provided for the poor; for it is here where the initial stage of contagious diseases invariably germinates. The question of housing the poor, we all know, has been discussed from time to time during the past eighteen years, and hundreds of thousands of pounds have been expended on what has been called the improved system of building blocks of artisans dwellings, and I am free to admit that it is an improvement on the former state of things; but on the other hand it is (in my opinion) as yet far from satisfactory. Some of these blocks stack (so to speak) together as many as 1,000 individuals under one roof during the night. It is true a through ventilation is obtained in the day-time; but this is not secured during the night. To house the poor in such heaps is not the best way of meeting the difficulty; inasmuch as the rents are excessive and there is no chance of the tenant becoming the owner of his home, the number of people per square yard of land is excessive. The crowding together of so many under one roof tends to the absence of independence and has a demoralising effect. And again, the houses erected after the Local Government Model Bye-laws —demanding a through passage and ventilation, with ground space at the back or side—have a tendency, and do, create much self-sacrificing on the part of the tenant, inasmuch as the rooms have often to be let off to lodgers owing to the necessary high rents; whilst the back-yard premises often become occupied with poultry and an accumulation of rubbish, resulting in filth. I have therefore come to the conclusion that the back-to-back house self-contained (as so extensively constructed at Leeds on the modern plan) is the best class of house for the working man, for the following reasons :—

There is as a rule 4 square yards for each person under one roof, and nearly 11¾ square yards of appropriated land area (to centre of streets) as compared with the excessive number of persons per square yard under one roof in artisans' dwellings.

These cottages are built in blocks of eight—four back to back, with a twelve yards street in front, with a space of 15 feet at the end, or between each block.

The streets are well paved and the insterstices of the stones are filled in with asphalte run in hot, and the footpaths flagged.

The land upon which the houses are built is freehold, and invariably the tenant is the owner.

These cottages are the most cleanly of any such dwellings in large towns.

The outcome of all this is that the working classes are settled and nearly three-quarters of the householders are owners (through the Building Societies) of the houses in which they live.

As an instance of self-reliance, a working man in Leeds pays 3s. or 4s. per week including interest, until the principal and interest amounts to £40 or £50. He then withdraws and purchases a house for say £160 borrowing the difference, viz., £120 from the Society. But he has to pay 3s. per week to the Society for twenty years more when the house becomes his own; otherwise he would have to pay *as tenant* to a landlord 4s. 3d. per week, and the house would not be, of course, his own. Thousands of houses have been built in this way, and there is no part, so built, overcrowded. Compare this with, say the Victoria Square block for example, where a three-roomed house is charged 5s. 6d. down to one room 2s. per week, and no chance of the tenant becoming the owner, the death-rate when deaths in hospitals are taken into account in connection therewith is upwards of sixteen per thousand.

The true artizan has a horror of dependence, as all true Britons have; therefore an effect of patronising should be sought to be avoided by giving him a chance of self-reliance, control, and independence, and ensuring him (as I have shewn) of having the profits of his own savings.

The Royal Commissions' Report of 1884 condemned the leaseholders system as detrimental to the health and prosperity of the working classes. The Report says:—

"Evidence has also been given as to the system of the middlemen, of house jobbers, house farmers, or house knackers; for by all these titles are designated those persons who stand between the freeholder and the occupier, and who fix and receive the rent of tenants' houses. The covenants to repair, cleanse, paint, and keep the drains in order are attended with an indisposition to enforce the troublesome and costly process. The system of building on leasehold land is a great cause of the many evils connected with overcrowding, unsanitary buildings, and excessive rents. This appears to be conclusively proved by the evidence of Lord Wm. Compton, Mr. Boodle (the agent of the Marquis of Northampton), Mr. Vivian, of Cranbourne, and others."

Building owners endeavour to avoid this and the improved sanitary legislation, and complain of the excessive rates arising thereout.

Take Leeds as compared with a leasehold town. Here the working classes are settled, less discontent, less inducement to strike and leave the town having become owners of property in it.

There is a story of a titled gentleman who on arriving at Leeds Railway Station, and having some little time to look at the town, inquired of the porter what the place was noted for. "Why," says the man, "I don't know of anything but trade and religion here, Sir."

Forty years ago, previous to the introduction of Building Societies for the benefit of the working man, the death-rate was 40 per thousand; now it ranks with the healthiest of manufacturing towns in the Kingdom. The saving in life value in Leeds now as compared with even twenty years ago is calculated to be £82,229 per year, the value of a life being on the estimate of Dr. Farr at £159 per average head.

Next in importance to the construction and maintenance of cottage houses is the construction and cleanliness of the streets in large towns, and the quick removal of the filth therefrom. As there are papers to be read dealing with the disposal of the refuse, I will simply refer to what I may call the transient state of the construction of street surfaces.

The enormous saving cannot be estimated by the construction of public roads in large towns with improved (almost noiseless) hard wood pavement, or the improved asphalte; and by the constant removal of filth from the streets. At first thought this may not appear to be of importance, but the Authorities in large towns are (I am sorry to say only too slowly) beginning to realise the benefits which accrue therefrom. The great stumbling block is—What will it cost? and as it is one of the matters that cannot be clearly shewn on the books of the Corporation where the benefit arises, it does to an incomprehensive mind appear an extravagant work to form the streets of such material.

The noise of traffic, by the adoption of wood pavement, is reduced to a minimum, and the deadening of sound to the occupants of buildings adjoining streets is conducive to the health of the nervous system, and enables business to be transacted with ease and comfort. The preservation of horse-flesh, not only by reducing the friction in vehicles passing over the surface, but by the wear and tear of the vehicles, is enormous, and results in the working expenses of vehicular traffic being considerably reduced. The accumulation of dust and dirt is also reduced.

The joints or interstices of the material are, in Manchester, filled in with asphalte and tar, which further tends to prevent the accumulation of dirt.

There is no doubt, as many medical men throughout the country have shewn, that the floating particles in the atmosphere aggravate Bronchitis, and create lung diseases, as in manufactories where the dust of coal, sand, steel, cotton and hemp, also from stone quarries where the workmen suffer by inhalation. But the suspended matters in the air in large towns chiefly consist of dust from refuse and organic matter, and imperfectly consumed particles of coal.

The minimising of these defects, the protection of tradesmens' goods from dust and dirt, and the economy by utilising horse-flesh, all result in enormous saving which cannot possibly be shewn in the books of any public authority, but which above all must conduce to the health of the people, and so reduce the death rate—which means economy.

I would now refer to another sanitary matter, and that is the importance of a supply of soft water, especially to large towns. The benefits and economy arising therefrom in its various applications and use is enormous when the digits of account arising thereout are added up and the total ascertained.

I refer especially to the water-supply to the working-classes; which is now claiming the attention of the London County Council, and which has been the subject of inquiries by the Royal Commissioners, more particularly since 1850, to the present time.

The importance of securing a soft water for domestic purposes and for generating steam in boilers for motive power cannot be over-estimated. The hardship of having to use *hard* water, enforced upon the working-classes, is one of the most serious matters for correction for the attainment of health and cleanliness, inasmuch as it is evident to any observant mind that wherever excessive hard water is used, washing clothes are practically abandoned and dark clothes are substituted to save the trouble and expense of washing. Hard water involves the use of a considerable amount of soda and sometimes lime, which is destructive to linen and all washing garments. It destroys the colours and the fabric, and as the expense of a garment must be estimated by the cost it is to the individual from the time it is purchased to the time it is worn out. For instance, a working-man's shirt at first may cost say 3*s.*, and if washed say forty times would amount to 6*s.* 8*d.* for washing alone. The saving in labour and soap and in the destruction of the material would be at least one-half.

The saving in cooking and in the brewing of tea, and in bathing in soft water, results in economy and pleasure. The cleansing of the body becomes more frequent by having at hand the use of a soft water, which is a luxury, and therefore an inducement to its use, which is not the case where hard water is supplied.

This is not a philanthropic view to take on behalf of the working classes, but it may be said to be a selfish one, inasmuch as the health of the poor is a protection to the rich, for in the absence of such provisions for health which can be offered by the reduction of labour and expense in the materials used for cleansing. The rich cannot live without the poor, and as the germs of contagion float through the air for hundreds and even thousands of miles like the pollen of a weed, it naturally follows, and indeed it is commanded, that the cleanly home of the rich must be duplicated in the cottage.

The next important topic before the public is the purification of sewage before the effluent therefrom is allowed to discharge into rivers and streams. A great deal has been said of late—volumes of papers read and lectures given on this subject—and at least twenty schemes are now before the public which show that this object of purification can be attained. But when the cost of the work is analysed it is found next to impossible to carry most of them into practical use.

The filtration of sewage to gain this end is looked to with some prospect of success, both through land where it is in many cases effectually done, and through artificial filter beds; in the latter, iron in its various forms and pigments is brought to bear in solving the question. It is very dangerous to deviate from mother earth and abandon nature's purifier for artificial contrivances.

Notably in the case of Antwerp where, in 1851, extensive works were laid down for the purification of the water pumped from the river Nethe for the supply of the inhabitants of Antwerp. Briefly—filter beds were constructed in 1885 composed of spongy iron and sand, and everything went on well and in perfect order, and good results obtained until the scheme had been working some eighteen months, and most singular to say that after this period it was found that the soft nature of the water of the river Nethe, into which the sewage, from a population of 97,000 from three towns, flows, before it was pumped, softened, and dissolved the iron to some extent, and it was found that a thin film of carbonate of lime formed beneath the surface of the filter beds, with the result that the spongy iron has now to be applied by means of revolving filters. Of course this adds considerably to expense in labour, motive, power, and material; but it goes to show that this—one of the best specimens of purifying objectionable water has to be re-arranged and constructed. We must, therefore, look with caution upon all new patented schemes which set forth an artificial means for purifying sewage and water.

The subject that has been specially selected for consideration at the Conference is the Construction of Refuse Destructors. Certain papers have been selected describing various systems in use, some of which will be read by the inventors of the apparatus; but it must, of course, be clearly understood that the selection does not in any way imply the approval of the Congress with regard to any of the apparatus described.

CONFERENCE OF SANITARY INSPECTORS.

ADDRESS

By FRANCIS VACHER, F.R.C.S.,
(Fellow).

PRESIDENT OF THE CONFERENCE.

My first duty is to welcome you here, to a Conference which has been wisely and considerately provided for by those who have organised The Sanitary Institute Congress in this city. We may rest assured that our conferring together on topics relating to our duties and daily work will be beneficial to ourselves and increase our usefulness to the public we serve. I would suggest that the subjects selected for debate be opened simply and concisely, and discussed with calmness and moderation, and I trust that we may approach each subject unbiased, fully desirous to learn what we can about it, and not without diffidence as to our own attainments.

I have thought that you will possibly expect from me, as your President on this occasion, some words of counsel and advice, and as these are commodities all are more willing to dispense than receive, I shall not disappoint you. However, I will be brief. By reading, attendance at lectures, and some practical instruction, you (I am speaking to each individually) prepare for your examination which you pass in due course and obtain the certificate. Then, legally qualified, you apply for a post and obtain it, and forthwith the responsibilities and obligations of a sanitary inspector are yours. As you are a true man, your first question on being thus fairly launched for life's work is "how can I make myself as thorough and efficient a sanitary inspector as possible?" The counsel I have to give will, I think, assist you to answer this question.

Do your utmost to conserve your health. I put this first, because with the arduous duties you are called upon to perform health is absolutely indispensable. Many hours of your day are commonly spent in squalid courts and squalid homes, and if you are to pass scathless where there is disease and death and every noxious thing, you must be in good condition, like the athlete trained for a contest. As you can hardly escape breathing much foul air at work, have a care that the air you breathe in the evening, when work is done, and at night, is as pure as you can obtain. When it is practicable, live in the suburbs or right out in the country. Sleep from 10 or 11 o'clock till 6, and see that your bedroom is directly supplied with fresh air. Provide yourself with a bath-room, and be sure that personal cleanliness is a first consideration. Accustom yourself to daily exercise (walking or cycling) in the fresh air. Take your meals regularly and let your food be nutritious and digestible. Alcoholic liquor you are better without; and as for tobacco I would say that if you want soothing you have not reached the standard of health an inspector should attain to.

Continue your studies. Do not think that because you have passed an examination you may cease studying. Education is only begun at school or in preparation for a profession—to be worth anything it must be continued through life. Read systematically a little every day, and be careful to select the best text books. Be gradually acquiring more and more information in the various topics connected with your vocation. Do not be discouraged by the contemptuous term "a smattering,"—what but that can anyone attain to when the field is so wide? However, if there is one subject more than others that deserves your special attention, which will be more than others useful to you, it is physics—the science treating of the general phenomena of nature with their causes and effects, and of the varieties of energy which we know as heat, light, electricity, &c.

Cultivate a habit of minute observation. You have heard of Sir Richard Owen, the naturalist. When he was a young man in the Artillery Company, at the coronation of the Queen, he was put on guard at Bunhill Row gate. Whilst standing there he began to observe the movements of the jaws of the sheep as they ruminated—he noted that the movements were all in one direction, and numbered from thirty-three to thirty-seven between each swallow. Thus Owen quite early in life took note of what others would neither see nor think of. Lyell, Agassiz, Darwin, Pasteur (I could mention a score of names as familiar), had also this happy characteristic of seeing what those around them failed to see. You have heard the old story "Eyes and no eyes." Two lads took the same walk over the heath and through the meadows,—one saw nothing, while the other was stirred with delight as nature displayed for him the marvels of plant and insect life. What you see and prove is more really your own than what you know of or learn. Book-study counts for much, but knowledge you win for yourself counts for more.

Cultivate, then, this habit of close observation. Inseparably associated with it is the habit of inquiry. Both will develop together. You will see many things you do not understand—never weary of asking "how" and "why." Newton saw an apple fall and asked, why? After years of thought and work came the answer—the law of gravitation. James Watt sees the lid of the kettle lifted and asks, how is this force to be utilized? Years later came the answer—Watt's steam engine. The inspector who looks close and inquires the reason why, is the man who is quick at resource, solves little practical problems, extemporizes tests, discovers the cause of effluvia, and finds a way out of any ordinary difficulty.

Be explicit and exact. Mr. Matthew Arnold has sung the praises of lucidity, and no doubt in argument or exposition being lucid (clear) is of first importance; however, the inspector is not ordinarily called on to argue while he is daily making statements and writing reports—what is specially required of him is explicitness and exactness. Explicit means literally "unfolded"—an explicit report or statement unfolds the whole matter. An exact report or statement gives precise particulars. Now the great defect in the reports of young inspectors, new to their work, is that the statements therein are more or less vague and indefinite. A report is a formal document or entry in a book, and the information it conveys should be exact and complete, or it is of no value. When I read in a tradesman's circular that "an enormous stock of most fashionable summer goods will be offered at an alarming sacrifice," I am not surprised at a little hyperbole or want of exactness in the announcement. Advertisements are commonly written in what has been euphemistically called "the language of commerce." When, however, an inspector reports, with equal vagueness, that the common lodging houses in his district were inspected and found in fairly good order, or that the dairies, cow-sheds, and milk-shops, were on the whole satisfactory, I am both surprised and dissatisfied.

For any use I can make of such a report, it might as well never have been written. As regards common lodging houses, I want to know how many there are in the district; if they are all duly registered; the extent of accommodation provided; the number of inspections made; if any cases of infectious disease have been reported; the number and nature of offences (under the local bye-laws) detected; the number of prosecutions instituted; the results, &c. As regards dairies, cowsheds and milk shops, I require information on the same lines. How many dairymen are registered; have the local authority made regulations in respect of the trade; the number of inspections made; if any

cases of infectious disease have occurred on dairy
particulars of the offences detected and prosecutions i
I could give many other examples of want of explici
have said enough to make my meaning plain.

Be methodical and orderly. This piece of advice ma
you altogether less important than what has preceded
haps it is so, yet I venture to assert that attentior
absolutely necessary if you aim at taking "a front
the Americans say. When local authorities are co
whom to advance to the position of Chief Inspector,
of robust health may be passed by, and the studious
the sharp man, and the exact man, whilst the man wl
recommendation is that he is methodical, may get the
and is quite likely to.

Method and order in an office are of such manifest con
representing such an economy in time, that they are
However clever or brilliant or fertile in expedients a ma
if he works without system, men having half his abiliti
advanced before him. And do not forget that me
order are not necessarily inborn characteristics, but
acquired. They are certainly worth acquiring.

I need scarcely add that if you would succeed you
your work, giving your mind and heart to it. The fig
always to the strong. Talents and accomplishments
but the enthusiasm and energy born of love must win.

STANFORD LIBRARIES

CONFERENCE OF LADIES ON DOMESTIC HYGIENE.

ADDRESS

BY THE LADY MAYORESS OF LIVERPOOL

(MRS. W. B. BOWRING).

PRESIDENT OF THE CONFERENCE.

IN opening this Conference on Domestic Hygiene, it is neither necessary, nor would it be fitting, that I should occupy your time with an address of any length—seeing that we are to listen to-day to papers read by those whose wide experience and depth of knowledge render them far abler exponents of the theories they wish to promulgate than I could possibly be. I will, therefore, confine myself merely to a few general remarks upon the subject which we are assembled here to discuss, and the reasons why it is well that we, as women, should in this Sanitary Congress have a recognised position to maintain and an organized gathering of our own. It has been truly said: "Architects may build houses which in point of structure shall be very temples of Hygeia, but woman will ever make them nurseries of disease and death so long as she ignorantly violates household sanitary law;" and yet in spite of the accuracy of such a statement how little is done, or rather how much more is needed to be done, in order to train girls to a right estimate of the value of those sanitary laws, and to give them an opportunity to acquire that intelligent knowledge of hygiene and sanitation which is so absolutely essential to the physical and moral welfare of both individuals and communities. In these days of advanced thought we hear much of "the rights of women" and "the revolt of the daughters," movements that have for their aim the increased freedom of the sex, but still, when all is said, the household—the home, remains woman's true kingdom, it is there her sway is paramount, it is there her influence is supreme; its interests should be her first consideration, its maintenance and improvement lie nearest to her heart. How best to inculcate the desire for this improvement amongst our less fortunate sisters; how most wisely and sympathetically to impart such teaching as will conduce to a higher standard for their health and for their homes, should be, it seems to me, the key-note of our conference to-day.

There never was a time when sanitation, or to put it more plainly "health in the house," was so much discussed, so talked of, so written about as at the *present* time, one might almost say that it has become a fashionable craze and that in the flood of sanitary books, pamphlets, publications and lectures poured upon us there is some fear of our being swept away by a deluge of theories beyond our grasp, instead of standing firmly on the solid ground of practical common-sense; and old-fashioned people are apt to shake their heads and quote "when ignorance is bliss 'tis folly to be wise." How much the better or happier are we they say, for our painfully acquired knowledge of "bacilli" and "bacteria" and "germs," what need to be told that disease and death may lurk in the air we breathe, in our food and drink, in the very dust beneath our feet; to these we would reply—much every way, because disease is preventable, and death may be postponed, and even a *little* knowledge is *not* a dangerous thing if that little is accurately learnt and can be imparted intelligently to another less well informed.

It is not intended that in these matters women should trench upon the province of men, but the drainage, ventilation, and lighting of our houses, the purity of water, milk, meat, &c., the proper preparation and cooking of food, cleanliness in the person and house, the care of children and nursing of the sick, the management of infectious diseases and removal of all impurities that may gender disease, these and kindred subjects should come under the teaching of domestic economy, and every girl should have such a thorough training and examination in them, as will enable her to leave school equipped with real practical knowledge that cannot fail to be of the greatest help to her in after life.

This training should be, I consider, available for rich and poor alike, for if needful for our own children, how much more desirable is it for the children of the poor who have to fight the battle of life against such terrible odds in our great cities and in the rural districts of our land. In the scheme then of technical education, side by side with classes for cookery, laundry work, sewing and the like, it seems to me that some teaching of what I may call the first rudiments of sanitation should find a place, and children should be taught, as far as possible by practical demonstration, the groundwork of real house-wifery; a few simple lessons on the structure of the human frame, illustrated by diagrams, might be used to explain what are the requirements of these bodies of ours in order to maintain them in health; and the principles of ventilation, the why and wherefore of good air *versus* bad in our homes might be explained. Such a scheme has been adopted in London in connection with the Board Schools, and is found to work well; some of the questions set for the "house-wifery" examination of these classes in July last, have come under my notice, and while simple and easy of comprehension they are all framed with a view to their utility. That such classes have not been formed elsewhere in connection with the board schools of our provincial towns may possibly be due to the somewhat expensive machinery required, for in order that the children may be effectually taught and trained, it has been found necessary to fit up and furnish two or three rooms, a miniature "house" in fact, where all that pertains to the requirements of kitchen, bedroom, sitting room, &c., are provided, and in which there is daily manual practice in actual housework conducted on sanitary principles, The girls are instructed in the kitchen how to guard against waste in the preparation of food, and how to dispose of the refuse that is so often allowed to accumulate in the dwellings of the poor until it becomes a source of danger and infection; in the bedroom the best method of safe and effectual ventilation without draughts, and how to keep it wholesome and clean; and in the parlour how to combine beauty and comfort with strict economy, and to make it cheerful and bright and pleasant upon such small means as a working man has at command. This is what has been and what ought to be done for the children, and side by side with the desire to train the younger generation to a useful knowledge of the laws of hygiene, there comes naturally the wish to improve the habits and condition of the women, of the wives and mothers and sisters of the working men, in whose hands lies so largely the power to make or mar the comfort of the home.

For some time there has been a movement stirring in this direction, ladies trained as Health Lecturers have in many districts given short useful addresses at mothers' meetings, plain talks on household topics, in which they have sought to gain the confidence of the women, to sympathise with, and counsel them in their household difficulties and family cares, and while plainly pointing out the evils resulting from dirty slovenly habits, and want of order, encouraging them in every desire for improvement, proving to them by clear and practical demonstration that life or death may lie concealed even in a grain of dust, or a drop of water.

To be thoroughly helpful, however, these lectures should, I think, be followed up by home visitation where practicable, when by the exercise of tact and kindly feeling many useful hints may be offered, without giving offence, on the sanitary

condition of the person and the house, and the man
health in both adults and children. This plan of send
missionaries into the homes of the poor has been
much success among women of the labouring class in
midland counties. I trust it may not be long before
also has its health missionaries, who armed with know
experience of domestic sanitation, may be found rea
those who are willing but unable alone to help themse
I in conclusion be allowed to quote the words us
Edward Seaton, Professor of Hygiene at St. Thomas'
London, in his report of the British Committee, rec
mitted at the International Hygienic Conference at
He urges that the scope of hygiene, which in Engla
too narrow a signification, shall be extended so as
sanitary or preventive medicine. Otherwise, he co
will be impossible successfully to combat diphtheria,
and other diseases which can only be properly terme
table when the public understand the necessity for the
encouragement of scientific observations and researc
on the public health."

STANFORD LIBRARIES

LECTURE TO THE CONGRESS,

BY GEORGE BLUNDELL LONGSTAFF, M.A.,
M.D.OXON., F.R.C.P.
(FELLOW).

THE OVERCROWDING OF HOUSES UPON LAND.

I DO not think it is at all necessary for me at a meeting of this Institute, or at a meeting in Liverpool, to say anything to you about the great importance of hygiene; but having received an invitation to come to lecture to you, it occurred to me that "the overcrowding of houses upon land" might perhaps be a useful subject to choose. A great deal has been said about overcrowding people in houses, but I do not think so much has been said about overcrowding houses upon land as the importance of the subject deserves. I am at the present moment particularly interested in this matter, because the responsibility has been thrown upon me by the London County Council of carrying through Parliament "The London Building Act, 1894," possibly the longest private bill that has ever passed, consisting as it does of 218 clauses. It has appeared to me that we are liable to certain dangers in the present state of sanitary science, and amongst them is a tendency to specialise, to get into too narrow a groove; I say, with great deference in the presence of so many Medical Officers of Health, that I have long thought that there is a tendency amongst members of the medical profession to pay too great attention to diseases of the zymotic class, and I think there is also amongst the laity who interest themselves in sanitary matters too great a tendency to concern themselves only with drains. It is a common thing with people to think that the word sanitarian means exclusively one dealing with drains. No greater mistake could possibly be made, etymologically or as a matter of fact.

I may remind you of this fact, that whereas in England and Wales the diseases of the zymotic or infectious class cause one-sixth of the total deaths, the deaths from phthisis or consumption and diseases of the lungs together amount to as much as one-fourth of the total deaths. And speaking of Liverpool, I may say the case is even more striking. In last year in Liverpool—I will not trouble you with the numbers—one-sixth of the deaths, as in England and Wales, were from diseases of the zymotic class, but no less than one-third were from diseases of the lungs—including phthisis. What is the inference to be drawn from this state of things? Surely that those diseases which destroy the greater number of lives must be themselves most deserving of study.

In the first place, speaking generally, diseases of the lungs must be caused by something or other connected with the air, and it has been amply shown by your neighbour, if I may so speak of him, Dr. Ransome, of Manchester, and others, that the especial cause of some of these lung diseases is bad air or defective ventilation. Now, ventilation is a very difficult subject from the engineering or mechanical point of view, and I feel very little doubt that we may experience some of the difficulties of ventilation before this meeting is concluded. But even more serious than the mechanical is the moral difficulty. The appliances you provide are not used. People will shut up windows and appear to rejoice in living in a stuffy condition of the atmosphere, which I cannot help thinking must be gratifying to the *bacillus tuberculosis*. Nevertheless, if people are to have means of ventilating their rooms it is necessary that they should have air round their houses, and this is the particular point I wish to call your attention to to-night.

There is another reason which makes this a subject of particular importance in the present day. You are probably aware, no doubt you have heard a great deal on the subject, of the movement of the country populations into the towns. Well, now, this is a matter of which I have made a considerable study, and I think it is quite possible you may not be aware that the movement of populations from the country into towns is not a peculiarity of England, but is actually occurring in every country in the inhabited globe that publishes any statistics. It may differ in degree—no doubt it does—but so far as I am aware it occurs in its greatest extent probably in two such different places as France and the colony of Victoria; also in New England and other parts of the United States. The movement from the country to the towns is one of the most serious social facts; it means that a large proportion of the young must be brought up in towns. We all know very well that towns, from the very nature of things, are less healthy than the country, and therefore it is especially incumbent upon us to do everything we can to diminish the evils at present affecting them. For instance, just to give you an idea of the change that is going on, let me quote the census returns. In 1861 there were 63 per cent. of the people in England and Wales living in towns, but at the last census of 1891 there were 72 per cent., or nearly three-fourths. The majority of these must necessarily follow occupations more or less sedentary. The more laborious occupations of the artizans are more and more performed by machinery, so that the men who crowd into towns have at the same time less chance of attaining health, and less opportunity for physical development. I am happy to say that in England, to a degree which does not probably exist elsewhere, the strong and vigorous spirit of the people leads them always to keep athletics in the front, and in that lies possibly the salvation of our rising youth.

There are two forms of athletics which have come into use within my own recollection, which are of general application, and to which I attach the greatest importance. There is the doubly useful institution of volunteering, which appeals to the patriotism of thousands of people, and is of immense value in taking them out of the towns and giving them healthy exercise, and there is also the great development of cycling.

One of the best social signs we see at the present day is the rapid spread of parks and open spaces, for which, I think, our thanks are largely due in the first place to the enthusiasm of Miss Octavia Hill, to whom England owes so much, and in the second place to Lord Meath. Under the influence of such men and women they have, as the Americans say, "caught on." Everywhere there is an addition to our parks and open spaces. I am a member of the minority of the London County Council, and I usually vote on the wrong side, but I am happy to say I have voted time upon time in the "aye" lobby for the purchase of parks and open spaces, and have been every time on the winning side.

I wish to say something personal to the inhabitants of this city, and if I say anything against Liverpool I hope and believe that I say it in the most sincere spirit of friendliness, amongst other reasons because some of my ancestors were either baptised or married in St. Nicholas' Church. Liverpool is a specially interesting place to sanitarians, for from the first beginning of sanitary statistics it occupied the conspicuous position of being the very nadir of sanitation. In every column of figures issued it was at the bottom of long lists of death-rates, thus showing its appalling insanitary condition, and this went on for a very long time. Do not think that Liverpool by so doing did no service. If it had not been for the shortcomings of Liverpool I do not think that sanitation would ever have reached the successful point at which it now stands; so that the awful example that Liverpool set in self-sacrificing herself did more to advance the cause of sanitation in this country than perhaps anything else.

We can only make advances in sanitation by starting from something very bad, and I think there are three things which may distinctly be put down as great levers of progress: first, there was the cholera epidemic of 1849, which stirred the whole country in such a way as it has not been stirred since; secondly, there was the Crimean war of 1854, and the sufferings of our troops before Sebastopol, to which we owe nearly the whole of modern hygiene, not only in England but in the whole world, and to which we owe the present excellence of our system of hospital construction, barrack construction, and I think I may add school construction. We owe more to that war than to anything else, except possibly to the high death-rate which existed in Liverpool.

Now something must be said in explanation of this. You are all aware that at the end of the last century, and in the early part of this century, there was an unprecedented development of manufactures in Lancashire and Yorkshire. The increasing development of machinery led to the rapid employment of larger and larger numbers of operatives. They were drawn from the agricultural districts, and poured into the towns to get the high wages paid in mills. On this account two or three things operated and produced most disastrous results. These people wanted houses, and houses had to be erected near their employment, so it was necessary to crowd them together. They wanted houses at low rents, and it was necessary to build them cheaply. Then look at it from the moral side. It was said that these people came from little hovels in the country—very likely mud houses—where they lived many in one room, and were greatly overcrowded; and no doubt the houses given them in Liverpool and other towns were better than those they inhabited before. But people did not see—they did not think—they had not sufficient scientific imagination to see, that it is one thing for a man to live in a mud hovel in a tiny village, and quite another thing when there are one to five hundred, or even five thousand houses crowded together without any surrounding country air, or any of the other mitigating circumstances which environ the agricultural labourer. Well, people were housed in this fashion, and what the consequences were we know pretty well. Liverpool people know, because they are paying very heavily for them at the present day.

That was the stone age of sanitation, there was practically nothing known about it, or anything thought about it. But two things happened in 1847; there occurred the great famine in Ireland, and as you all know, some of you may remember (I do not remember it myself because it was two years before I was born) that famine was accompanied by the emigration of large bodies of poor Irish people, who came to Liverpool to seek employment. They came at the same time as Liverpool was rapidly developing, and were attracted by the demand for labour at the docks; because as factories grew in Lancashire and Yorkshire, the docks had to be increased to make way for the growing traffic. They poured into Liverpool, and no doubt stimulated the building of houses, which they overcrowded. It is difficult to say what the death-rate of Liverpool was in 1847, because it is difficult to estimate what the population was; but it is known that a large number of additional persons were in Liverpool in that particular year who afterwards spread about and settled down. Your Medical Officer of Health (Dr. Hope) informs me that the death-rate was 62 per thousand in that year; it is even said to have been 69, but I think you will be on the safe side when you say that the death-rate in the whole borough was not under 60 per thousand. These Irish had more or less settled down when in 1849 there came the great visitation of the cholera. We know much better what the population in Liverpool was in that year, and I think we may safely say that the death-rate of the population of the borough—not of any one slum—was 46 per thousand. So much for the worst state into which Liverpool fell.

What happened in the Crimean war when things got to the worst, happened to you, and the Corporation most manfully put their shoulders to the wheel, and I think they have kept it there ever since, with very considerable results. If you look at the table I am exhibiting you will see the numbers of deaths in Liverpool in five successive periods of ten years each. When you take long periods of ten years each, the average death-rate appears very much better in any place than the death-rate for a single year. You will see that forty years of labour have resulted in bringing down the death-rate from 36 to 26 per thousand of the population. The population of the city during that period has increased from 286,000 to 518,000, or not far short of double; the city has now increased its municipal boundaries, and the real aggregation of people is very much larger.

You will perhaps see the whole matter more clearly when I tell you that had the conditions which prevailed under the lowest of those periods of ten years still continued you would have been losing each year 5350 lives which now survive. I think those who are ratepayers must admit that the expenditure of rates is warranted when you have the favourable result of saving 5350 lives each year. Nevertheless, I am informed on the authority of the Medical Officer of Health, that Liverpool is still the densest city in Great Britain, and I spent this morning, not agreeably in one sense though not distressingly in another, with your excellent building surveyor, Mr. Goldstraw, in going through some of the most attractive portions of Liverpool, starting from the Municipal Offices and wandering about in a direction towards this College. We saw the worst that Liverpool has now to present. The really fine sights of Liverpool have been destroyed by the energy of the Corporation, and I believe Mr. Goldstraw was almost disappointed, that he could not show a Liverpool slum completely up to the mark. He did, however, take me over an area comprising a block of buildings which I am informed has a population of no less than 2,000, (and one therefore in regard to which we may somewhat trust the figures); whose death-rate for several years has reached from 50 to 60 per thousand. These are large numbers, much larger than Liverpool's most unhealthy wards, and they are comparable to Liverpool's death-rate in the year of the great Irish famine and the epidemic of typhus fever that followed it.

It does not do to take a picked area, but I find you have seven wards with an aggregate population of 108,000—and therefore a population which is free from the statistical fallacies which attach to small populations. If I take five—St. Paul's, Great George, Pitt Street, Scotland, and St. Anne's—with a population of nearly 95,000, I find that the average death-rate over ten years—1883 to 1892—was 34 per thousand. Then if we take Exchange and Vauxhall wards, which come to the very doors of the municipal offices, and have an aggregate population of 13,400, the average death-rate was 41 per thousand. I don't find anything quite like that in London. I am not able to give you rates for smaller areas, but Scotland ward in Liverpool, with a population verging on 34,000, has a death-rate of 34 per thousand, higher than the rate in any division of London. The Strand Division, with a population of 24,000, has a death-rate of 33 per thousand; Whitechapel, population 75,000, 27 per thousand; St. George's-in-the-East—also overcrowded—population 46,000, death-rate 29; and Holborn, population 33,000, death-rate 30 per thousand. You see the highest we get in London is 33.

Before going further, I should like to add there is one other test, sanitarians are accustomed to apply to populations, and one which, for obvious reasons, gets over some difficulties—that is, to compare the number of deaths of young children to the births in the same year—by which you know the population and the deaths. We then find that these same districts of Liverpool have nearly all of them death-rates far higher than that of the City of London—very high indeed—running from 202 to 247 deaths under one year to the births. In this way you have confirmation of the fact that your death-rates are very much higher than in London, where, in the worst districts, we get from 155 to 229. There is a district—the East-end of London—which resembles the North-end of Liverpool in this respect, that both are largely inhabited by what I may call, in the strict sense of the word, foreigners—largely inhabited by people of another race, who come over from another country; people largely distinguished by different habits, which habits are generally not better than those of the country which receives them, and people speaking generally, in a low state of civilization. Of course I allude to the Irish in Liverpool, and the foreign Jews who have recently invaded London. In the case of each there are poverty, overcrowding, filth to a very considerable degree, and bad habits generally. But they differ in two respects. The Irish in Liverpool die rapidly; the Jews in London die slowly. It is a considerable trouble to our Medical Officers of Health—no doubt Dr. Hope here thinks he has his trouble—but Mr. Shirley Murphy cannot make out why in Whitechapel they die no faster than in other parts of London. It is this fact which has caused him trouble. Some say it is the vitality of the Hebrew race. I do not know.

After inspecting the Ford Street area I had some conversation with a remarkably fine sergeant of police, and with such a fine specimen I thought there was something to be said for Municipal Police. I cross-examined him about the habits of the people, and asked him whether there was much drinking in the neighbourhood. "Well," he said, "not so much." But after a while I found that this statement was relative. "There might be some places where there was more." It was quite plain this policeman would not give them a character for sobriety. But when I inquired from a police constable, who accompanied me round the Bell Lane area (in Whitechapel), he said, "I have been on the beat two years, and I think I have only seen two drunken people." That, I believe, constitutes the difference between the two—that whereas the Irish affect "Mountain Dew," I think the Jew prefers the beverage provided by the East London Water Company. I do not wish to make any sensational statements, although I am a temperance man, because I think they are often much exaggerated ; but I do think anyone who knows the miserable condition in which the poor live, must feel that if to their other conditions there is super-added drinking, there is less money to spend upon food and clothing and their homes; that their children are more neglected; that it means a lower state of living, and thus among the poor, apart from its direct effects on health, excessive drinking leads to an enormous increase in the mortality.

Dr. Farr laid down the definite law that the death-rate varied in mathematical ratio according to the density of population, and for a long time—particularly as long as Liverpool behaved itself, and had this high death-rate—it was true. Dr. Newsholme, in a careful paper upon the Peabody Dwellings, says that as regards these dwellings it is not true. Certainly that is the fact, but it must be borne in mind that those who inhabit these dwellings are a select population. You must remember this, that in a place where bad characters largely congregate you get a high death-rate. We began to learn before the Crimean war—since the army medical returns were first published, as Dr. Parkes has clearly shown, that the same causes produced the same effects, whether in England, the West Indies, or the Mediterranean. In every case where troops were overcrowded in barracks, there was an enormous mortality, especially from consumption.

As regards Manchester very good statistics have been prepared by Dr. Tatham (the late Medical Officer of Health of Manchester, and now Superintendent of Statistics under the Registrar-General), and Dr. Ransome, which showed—more particularly in reference to back-to-back houses—that the deaths from all causes, from phthisis, from diseases of the lungs, from zymotic diseases, and the deaths of young infants, increased according to the proportion of bad houses. I do not want to trouble you with figures, but I could have quoted to you the inferences of Mr. Shirley Murphy, drawn from the census, showing a similar state of things in London, that where the number of houses or people to the acre increased, there also the death-rate increased.

I am not able to show you to-night the slums of Liverpool, but through the kindness of the Editor of the *Lancet*, I can show you a number of photographs which have rather a remarkable history, and which were taken in the slums of Hamburg, a town that suffered so much from cholera. They are more picturesque than Liverpool slums, because they are 200 or 300 years older. [The slides were then thrown on the screen]. Now I do not think anyone would expect a high standard of life in such places, but I do not think there is anything so bad in Liverpool. Now I want to tell you one thing more about these photographs. The Germans, as you are aware, are an exceedingly enlightened people, which certainly I should be the last to deny, but it almost surpasses the imagination to know that when the publisher of these photographs went and had the industry to photograph the slums in order to stir up the local authorities, the latter intervened, captured the whole lot of pictures, and refused to allow them to be sold! I do not know whether Liverpool does that, but it does not commend itself to me as a wise line of action. Lest I should be thought severe upon Liverpool, I wish to say that I cannot exaggerate the good work done by the Corporation in recent years. There is scarcely a court, certainly not a street, which does not show the active interference of the Corporation in trying to improve matters. I could not help feeling sympathy for the Liverpool ratepayers when I saw what had been done. The first thing they did was to let air into these courts, and accordingly—apart from so-called sanitary improvements—they took down houses to let air in; and where high walls surrounded courts and prevented the circulation of air they replaced them by iron railings. In this way they did an enormous lot of work, but nevertheless they found that what they were doing was not sufficient, that they must go further and have recourse to legislation.

There is an especial evil which affects more particularly the North of England, and that is what are known as back-to-back houses. A back-to-back house is one which has no back windows, no back door, and but one external wall, and I do not think it needs very much to show you that such houses must necessarily be very unhealthy. It is impossible to get a free current of air through such a house, and if it has a north aspect it cannot have the sun shining into it. With the excellent statistics of Drs. Tatham and Ransome, we can accept the fact that in proportion to the number of back-to-back houses, the death-rate increases.

Now I have mentioned the importance of sunlight. As long ago as 1844 Mr. Nathaniel Bagshawe Ward, the inventor of the "Wardian case," gave evidence of a general character before the Health of Town's Commission on the benefits of sunlight. In 1877 Messrs. Downes and Blunt first brought experimental evidence to show that sunlight is destructive to the life of bacteria, and in the present year—fifty years after his namesake — Dr. H. Marshall Ward has completed a most elaborate series of experiments on various species of bacteria—some disease-producing and some harmless bacteria—and in all cases he has found that sunlight kills them and that even strong diffused daylight is adverse to their development. Here, as in so many cases, science, which has been called by a great writer organized common sense, supports by rigid proof the every-day evidence that sunlight is healthy and good for people. In this association I should like to mention the name of the late Mr. Allison, Surveyor for Manchester, whose plans of back-to-back houses, published by him and Dr. Tatham, give the fullest information, and of which, together with the pamphlet, every one in a crowded town ought to make himself master. As I said, the efforts of your Corporation proved vain, and they found it necessary to take powers to prevent the erection of such buildings in future. They then adopted what is practically the Model Bye-law of the Local Government Board—that is to say, at the back of every house there must be left a certain space in proportion to the height of the house. This was in operation in Liverpool from 1864 to 1889, when your Building Surveyor, Mr. Goldstraw, who had been for some time the responsible officer for carrying it out, found that it operated with considerable harshness. [A slide was then shown illustrating the Model Bye-law of the Local Government Board under which all houses are to have an open space at back according to their height.]

I think those of you who are householders must know that there is such an institution as the scullery, or washhouse, and it is extremely convenient to have these at the back. Mr. Goldstraw thought—I believe the idea is entirely due to him—that there would be no harm in allowing at all events some portion of the rear space to be filled up with buildings, provided they did not rise above an angle of 45 degrees. He thought there would be no real harm, but that it would be a great advantage in the case of small houses, and allow ample circulation of air. Having examined the bye-laws in various places, the London County Council came to the conclusion that the Liverpool Building Law was the best in the United Kingdom, and accordingly it was taken as the basis for the London Building Act, 1894, which comes into force on the 1st of January next. I may add that in my opinion, in spite of all the labour spent upon that Act, the Liverpool Law still remains the best building code in England.

Now I think it will be convenient for me to deal with the matters that are illustrated by the lantern slides. The existing law in London permits the erection of such buildings as these: Here are plans of what are called artizans' dwellings in New Park Street, Southwark. They are overshadowed by a factory of six storeys, and the people who occupy the rooms at the back look upon a dead wall at a distance of 6ft. 1in. Here is a picture of the Peabody Dwellings in Victoria Street, Westminster. The Hotel Windsor is separated from them by a narrow street of 13ft. 9in. Here is a spot called Richards Place, upon which some philanthropic person—it is always the philanthropic person who does this—has built industrial dwellings. In them you will see picturesque sanitation, the W.C.'s being carried on girders above the middle of the court. I will now show you a diagram lent me by Mr. Robt. Williams, an architect who has devoted a good deal of time to writing in support of the increased powers given by the London Building Act just passed. These dwellings were erected quite lately in Whitechapel—in fact, I think they are not yet finished—and they are six storeys in height. That one has seven storeys. They will not be well favoured in the matter of light and air, because the total area of the site is 1,700 square yards, and 1,300 people are housed upon it. I ask you to imagine what chance of health these people will have. Here is another plan lent by Mr. Williams, and it shows the especial peculiarity of London I wish to call attention to.

There is a difference between slums that are made and slums that grow. In Liverpool they are made; in London they grow. In Liverpool, the worst of all conceivable plans was deliberately adopted and for years carried out on an enormous scale. In London, rural suburbs gradually turn into slums. In that street in old times there were houses with gardens; the modern plan has been to erect dwellings and cover the whole of the gardens. The once ample open area is now only a small one. Here is a picture of erections in Little Wild Street, St. Giles's, and is an instance of grossly insanitary buildings being erected as recently as 1883. What chance can these buildings have of securing light. The St. Giles's Board applied to the Metropolitan Board to do something in the matter, but the latter said "No, the Metropolitan Building Act is complied with." At a later stage they applied to the County Council, in the meanwhile the Housing of the Working Classes Act had been passed, and we got some of these storeys closed. Therefore we had the anomaly of a building erected as late as 1883 in compliance with the building laws of London, and which by another Act was closed as unfit for human habitation.

I have been told over and over again that the Bye-law introduced by the London County Council was a spoliatory measure. I maintain that as long as Parliament by one Act compels the authorities to pull down insanitary dwellings, it is time you should interfere to prevent such things being created under your very eyes.

I am a member of the minority of the London County Council, what is called a "moderate," but beyond that I hold that the art of good government is to interfere as little as possible with the people. I am not in favour of grandmotherly legislation. I would even go so far as to say, as a sanitarian, that the Public Health Acts have gone at least as far as the law ought to go in interfering. I am even inclined to think that in several respects they have gone too far. The whole bias to my mind is against interference, but when we are impelled by circumstances stronger than ourselves, when we are obliged to defend ourselves against our neighbours, and when we find that the free action of competition leads to such evils as have resulted in Liverpool, then it is high time in all towns to interfere and say, such things shall not be done in the future.

I think this discovery by Mr. Goldstraw of what is known as "the limiting angle" is of great importance, because it secures the greatest amount of air with the least interference. I have been in some of the houses to-day, I have seen the operation of the Bye-law, and I do not think anyone can say that the interference with the rights of the owner is excessive. The amount of light and space given is absolutely the minimum required. We asked for an angle of 45°, but Parliament has only given us one of 63½°. These models show what that implies. In London we have limited the maximum height of houses to 80 ft., and we have secured some legislation you have not in Liverpool. You will see from some of these plans that it has got more and more common to erect large buildings, large mansions, large hotels, &c., and in order to get light to these buildings it is necessary to construct internal courts or shafts. These courts are apt to be most insanitary, but the new Act contains rigorous provisions to secure that they shall not be too constricted; moreover, the width of the area between blocks of buildings must be equal to half their height. In this point at all events London is ahead of Liverpool.

I do want, in conclusion, to say that I do not think I can exaggerate the importance of this question of building legislation. As a member of one of the local governing bodies—one of our District Boards of Works—something like twenty years ago, I had a great deal to do with this question, and I came to the conclusion that the great want in sanitary legislation was to increase the restrictions as to the open space round houses. My connection with the London County Council, and my experience as Chairman of the Building Act Committee, have greatly increased that feeling, and it is one of my greatest pleasures, as Chairman of that Committee, that I should have been instrumental in leading through Parliament a bill achieving that object. But we have only achieved part of our object. We sanitarians are apt to be enthusiasts and ride our hobbies to death, and it is quite possible that the sober common sense of Parliament has given us as much as we should have. To those connected with municipalities which have not strong building bye-laws, I say "agitate, agitate," because it is really an important matter. We have spent £10,000 in passing the Bill—I believe our opponents spent more—but I consider that one single clause will save the County Council half-a-million of money. I say that putting it as a mere matter of pounds, shillings and pence. So far we have been content with much stronger powers for the houses of the working classes than those of the other classes, because the latter can live in any street they like, while the working man in too many cases cannot choose; and moreover, we find that overcrowding to the worst degree occurs in the houses of the working classes—with one exception. The two most insanitary sorts of dwellings are those of the working classes and the great blocks of mansions, and I feel convinced that those clauses which limit the height of such blocks, and which regulate the admission of light and air into them, will confer most substantial advantages upon persons of the better class.

LECTURE TO THE WORKING CLASSES,

By Sir JAMES CRICHTON-BROWNE, M.D., LL.D., F.R.S.

THE PREVENTION OF TUBERCULAR DISEASE.

I BEGIN what I have to say this evening by showing you a lantern slide, and I must ask you to note it well, for it is a portrait of the arch-enemy of mankind; I mean, of course, in a material and not in a spiritual sense. These simple inoffensive looking little rods and threads, which, when alive, have not even the humble faculty of motion of their own, are the tubercle bacillus, as it is called—a microscopic fungus which is the one true cause of consumption of the lungs and of the bowels, of water on the brain, of scrofulous glands, bones and joints, of lupus of the skin, of all those tubercular diseases in man and animals, about the prevention of which I am to speak to you.

I daresay you are all aware that of late years microscopic fungi of this kind, or microbes, infinitely minute particles—so minute that, as Professor Crookshank has told us, 400,000,000 of them could stand upon a penny postage stamp—have been proved to play a stupendous part in mundane and human affairs. Our improved microscopes have enabled us to watch them; ingeniously devised systems of experiment have enabled us to interrogate them, and thus we have satisfied ourselves that the study of bacteria and their products is of the utmost importance to the welfare of our species.

Do not suppose, however, because I have introduced microbes to you in connection with the tubercle bacillus that all microbes are like it, of a malign and pernicious nature, engaged in the production of disease. On the contrary, microbes, like human beings, are good and bad, and to those of the former character we owe not merely many of the comforts and luxuries of life, but perhaps our very existence itself. Like the busy and benevolent fairies of the tales of our childhood, these good microbes, although invisible, are incessantly and diligently at work, and do us many a signal service. They brew our beer for us, and ferment our wine, for where would these be without the yeast fungi? they bake our bread for us by converting starch into sugar, and that into alcohol, and carbonic acid; they grow our corn for us by carrying on the process of nitrification in the soil; and they act as scavengers for us by the chemical changes they induce in decomposing organic matter.

But besides the good microbes we have the bad ones, and of these one great class—the pathogenic, or disease-causing—has been proved to be responsible for many of the worst ills that flesh is heir to.

These disease-causing microbes or bacteria (for they are all included under that name) are varied in form. When they are round or spherical, they are called cocci; when they are rod-shaped or cylindrical, they are called bacilli: and when they are twisted or screw-shaped, they are called spirilla. They vary also in their life history, and they vary very widely in their effects on animals and human beings. Amongst them we have the drum-stick bacillus that is responsible for tetanus or lock-jaw; Pfeiffer's bacillus, the short rodlets of which are believed to be the bearers of that influenza by which we have been recently so grievously visited; the clubbed bacillus of Klebs and Lœffler, which sets up that diphtheria, the increase of which amongst us is giving rise to anxiety; the well-marked bacillus of anthrax, that decimates our flocks and herds as splenic fever, and communicates wool sorters' disease to human beings; the flagelate bacillus of typhoid fever; the capsuled micrococcus of pneumonia; and the comma bacillus of Asiatic cholera, that is for ever ravaging the East, and now and again makes desperate raids upon Europe.

And really, when we consider these disease-causing, these reprobate bacilli, and think of their dire effects, of the pain and weakness, the anguish and sorrow and death that it is their mission to spread over the world, we are tempted to liken them, small though they be, to those fell potentates of diverse essences who, according to Milton, assembled in council in Pandemonium: Beelzebub, Belial, Moloch, Mammon, Rimmon, Chemos, and the rest of them, and who since then

> "Wandering o'er the earth
> Through God's high-sufferance for the trial of man,"

have been ceaselessly contriving against his happiness in open onslaught or in hidden ambush. And, as in the Stygian conclave of Milton's "Paradise Lost" there was one, uplifted high, "by merit raised to that bad eminence," Satan—the subtlest and mightiest of the infernal powers—so in the Synod of Bacteria there is a bacillus that stands forth paramount; the most cruel, inveterate, and relentless of all, and that is the tubercle bacillus, which I have already ventured to designate the arch-enemy of mankind.

And that the tubercle bacillus really deserves that appellation will be abundantly apparent when I tell you that the diseases to which it gives rise are the most terrible, deep-rooted and fatal of the scourges that afflict our present stage of civilization. In 1892, the last year for which returns are available, tuberculosis in its several forms caused 63,606 deaths in England and Wales, and in the year 1893, that is to say last year, it caused 1,731 deaths in this your City of Liverpool. Year by year tuberculosis is responsible for as great a sacrifice of life in your midst as occurred in the British Army on the field of Waterloo, while in England and Wales it kills annually nearly three times as many human beings as perished in the whole British Army in the Crimean War, killed in action or dying of wounds or disease. Could we but obtain an accurate record of the ravages of this ruthless destroyer—which is not like cholera, a thing of comparatively modern origin, for it has existed in all ages; which is not like leprosy, limited to certain areas, for it is spread all over the world—we should have an appalling revelation of human mortality. But the figures of such a death-roll, frightful though they might be, would but feebly convey to us the burden of misery and loss that tuberculosis has laid on our race, unless we reflected on the nature of tubercular disease and remembered that it involves in almost every case, not short, sharp pangs, but long drawn out suffering and distress. Water on the brain affecting children is soon over, but the other forms of tuberculosis are tardy in their course, and consumption, the commonest of all, has an average duration of from two to three years, lit up no doubt here and there by phosphorescent gleams of fallacious hopefulness, but dark, dreary and pain-fraught for the most part, and casting long, sad shadows around. If we remember further that tuberculosis carries off not the aged and worn-out but the young and the promising, that it selects often the brighest and fairest in the family circle, and that it takes a special delight in quenching the fire of genius and robs us of men like Spinosa, Keats, John Sterling, Kirk White, Hood, David Grey, John Richard Green, and Clifford, and of women like Charlotte and Emily Brontë and Rachel, when only half their work was done, we shall faintly realise the calamity that tuberculosis entails on our species, and that entitles it to be described as the arch-enemy of mankind.

Now this arch-enemy of mankind has only been properly identified of late years. Of course tubercular diseases have been long recognised and distinguished, but it was not until 1882 when Koch of Berlin undertook the most memorable research in modern pathology that their dependence on the tubercle bacillus was proved. Before Koch's time, the particular tissue degeneration that is always associated with tubercular disease, the tubercle itself, was well known, and it was also well known that it contained some kind of *specific* poison, for it had been shown that if minute portions of it are taken from men or animals affected by tubercular disease and inoculated into healthy animals, these become affected by tubercle, at first at the seat of the inoculation and then by gradual circles of extension throughout their systems generally. But the tubercle tissue, thus inoculated, is a highly complex structure, and it was Koch who demonstrated that its one essential constituent that carries the disease is the tubercle bacillus, that he first brought into view. By ingenious modifications in the use of staining agents in preparing the tissues for the microscope, he succeeded in showing that it invariably contains one micro-organism with special character of its own, different from all others, which he named the tubercle bacillus.

When prepared and stained by Koch's method, tubercle bacilli are seen as delicate rods or little clippings of thread, thin and rounded at the ends, straight or more commonly curved, lying singly or in pairs or rows, varying in size but generally 1·3 micromillimetres or microns in length, that is to say so small that it would take two or three of them, end to end, to stretch across a red corpuscle of the blood, of which there are 5,000,000 in a cubic millimetre of blood or a drop the size of a pin head. As represented on the screen, the tubercle bacilli look far from insignificant, but they are here magnified 60,000 times, and I may perhaps best convey to you what that means if I tell you that a pin an inch long magnified to the same extent would be one mile long, and that I myself, if magnified to the same degree, would, in a recumbent position, extend across the country from Liverpool to Derby, a distance of about 70 miles, and no doubt attract the attention of the inhabitants of Mars as a new and magnificent terrestrial ship-canal.

The constant association of these minute bacilli with tubercular disease was demonstrated by Koch. He showed that they are invariably present in the lungs of persons dying of consumption, and are to be found in the expectoration of such persons during life. He traced them in the ulcers of the intestines in children dying of consumption of the bowels, along the blood-vessels of the brain in those dying of water on the brain, in the marrow of the bones of those affected by scrofulous joint disease, in the skin of those suffering from lupus, and in the tubercular nodules, discovered in the bovine species, in the monkey, sheep, rat, mouse, guinea-pig, fowl, or other animal subject to tubercular disease. And more than that, he established that these bacilli are always most abundant when the tubercular disease is most active and where it is spreading into the surrounding tissue, and that they are never to be seen where tubercular disease does not exist.

But notwithstanding all these demonstrations, Koch was still far from having convinced his profession that the bacillus is the true cause of tubercular disease. The bacilli are, as I have said, most numerous around the edge of a tubercular nodule or mass, where it is growing and extending; they dwindle and become indistinct and infrequent as we approach the centre or original starting point where degeneration is most advanced, and where only the *débris* of broken down tissue remains, and in the centre, very often, no vestige of them is to be discovered. Now it was pointed out that if particles be taken from this centre of the degeneration, where there are no bacilli, and inoculated in an animal, copious crops of tubercles, all containing bacilli, are produced. The opponents of the bacillary theory, therefore, argued that the poison of tubercle is not necessarily associated with the bacillus, which is really a result of its operation or an accidental concomitant. But their argument was answered, when it was shown that the tubercle bacillus produces spores or seeds, specks much more minute than itself and of great vital resistance which may, like the seeds of plants, remain latent, as it were, in degenerated tissue long after the bacilli themselves have disappeared, to sprout into active life and multiplication whenever the surrounding conditions as regards nutriment, moisture, and temperature become favourable. These spores or seeds, although indistinguishable when isolated, may often be seen to the number of two to six enclosed in the bacillary rods, and they it is that communicate the disease when tubercular tissue without visible bacilli is inoculated, and that play a very important part, as we shall see, in the propagation of tubercular disease amongst human beings.

But still, even after the demonstration of the spores of the tubercle bacilli, Koch's proof was incomplete. In all direct inoculations of tubercular tissue from man to animals, or from one animal to another, many elements besides the tubercle bacillus or its spores are transplanted, and it is, of course, possible that one of these, and not the accompanying bacillus or its spores, has infective properties and may be chemically or organically the source of the transmitted disease. It was only by isolating the tubercle bacillus from all its surroundings, inoculating it and it alone into an animal with the result of setting up tubercular disease that an absolute conclusion could be arrived at. And this Koch has done. He discovered that the bacillus is not exclusively parasitical, but can live outside the living body which is its usual home, and he found that the solidified serum of blood, when kept at a proper temperature, is a nutrient medium on which it can thrive and multiply; and then by a series of most delicate manipulations he succeeded in obtaining pure unadulterated cultures of the bacillus. Under strict antiseptic precautions he dipped the point of a needle into a tubercular nodule in a newly-killed animal; he drew that point across the surface of some solidified serum in a test tube; he kept the test tube in an incubator at blood heat, and in a proper degree of moisture, but protected against any possible contamination by germs from the air, and he had the satisfaction of observing, in from ten to fifteen days, some small grey specks or tiny scales along the track of the needle point which expanded and coalesced, and which when microscopically examined proved to be pure colonies of the tubercle bacillus. From the cultivations thus made invisible specks on the point of a needle were transferred to other tubes containing solidified blood serum, in which colonies of tubercle bacilli again sprang up, and so on through many tubes and many generations of bacilli. And, last step of all, Koch took the pure cultures of tubercle bacillus thus obtained and inoculated them under the skin or into the blood or serous cavities of healthy animals, in which invariably in due course tubercular disease marked by tubercles, containing crowds of bacilli, was developed. He thus crowned the edifice of his great discovery, and put it beyond cavil for ever, that this little organism is the one true cause of tubercular disease—that arch-enemy of mankind seeking whom it may devour, the origin of the breathlessness, the cough, the hectic fever, the wasting, of all the dread symptoms that we associate with consumption, that feeder of our graveyards, the harbinger of the grief and desolation of many homes. Where this bacillus is present there we have tubercular disease; where it is absent tubercular disease is not, and hence it has now become a matter of routine practice to examine the expectoration in every case in which there is reason to suspect consumption. Our diagnosis is thus enormously aided. We are often able to banish unnecessary anxieties and fears; we are often able to detect the disease at its beginning when it is most amenable to treatment, and we are often able to estimate, by the number of bacilli in the expectoration from day to day, the rate at which the lung structure is breaking down. The doctor who, now-a-days, in any doubtful case, omitted an examination of the sputum or expectoration would be guilty of a grave dereliction of duty.

The tubercle bacilli being the true cause of tuberculosis—and that truth is now universally accepted by the medical profession—it is obvious that we must aim at the destruction of that bacillus, at a diminution of its virulence, at its exclusion from the body, or at its rapid elimination, should it have gained an entrance, in all measures for the prevention of tubercular disease. Koch thought to take a short cut to the abolition of tubercle. He had noticed that the tubercle bacillus is readily killed outside the body by various agents called germicides, such as corrosive sublimate, cyanide of gold, carbolic acid, ethereal oils; but, unfortunately, most of these germicides are poisonous to, or exert an injurious effect on the tissues, and so could not be employed for the destruction of the bacilli in the body, even had the tubercle been in positions accessible to their application in sufficient strength to prove fatal. But he knew that in certain cases, for instance, in small-pox, the action of disease-producing bacilli upon the body is modified by the use of vaccines—attenuated or mild cultures of the same bacillus—which accustom the body to the action of the poison of the bacillus and enable the tissues to resist it when presented in its more virulent form, or confer what is called immunity. He knew that the tubercle bacillus cultivated outside the body varies greatly in virulence, according to the nature of the food on which it is fed—the addition of a little glycerine to its diet weakens it considerably—and he hoped that he might attain an attenuated virus of tubercle, which would protect against tubercle just as the attenuated virus of small-pox—the small-pox bacillus after being fed on the tissues and juices of the cow—protects against small-pox when employed in vaccination. In this hope he was disappointed, but in his pursuit of it he hit upon some results of a very remarkable character and believed he had discovered an agent that, like Pasteur's inoculation against hydrophobia, would stop tubercular disease, even after it had obtained a foothold in the system.

The action of the tubercle bacillus on the living being is due not to its mechanical intrusion on the tissues, but to a poison it secretes, which enfeebles and kills the living cells of which the tissues are made up; and this poison Koch succeeded in separating from pure cultures of the bacillus as a glycerine extract, which he named *tuberculin*. In a diluted condition this tuberculin injected into the body was seen to have no perceptible effect on healthy animals, but to have striking effects on animals already affected by tubercular disease. In the latter it sets up general fever and local reaction around any existing tubercular deposits. It stimulates the cells in and around these deposits, induces dilatation of the blood-vessels and increased flow of blood to them, and leads, it is alleged, either to the softening, sloughing and removal of the tuberculous masses or to the formation of a barrier of sound tissue around them, preventing the migration of the bacilli into neighbouring parts, cutting off their supplies of nourishment and compassing their death.

I am not going to perplex you with the theories as to the mode of action of Koch's tuberculin, but there can be no question that it had powerful and even startling effects on the animals on which it was first employed, and on the human beings to whom it was subsequently administered. In lupus in the latter, the tuberculous parts were actually seen dying, as it were, sloughing away and leaving a clean healthy surface, and it was too hastily proclaimed that tuberculin was a cure for tubercle, and that an effectual remedy had been discovered for the most disastrous of human maladies. Thousands of consumptive patients flocked to Berlin to be inoculated, and at first the reports were favourable, but after a time it appeared that the recoveries under tuberculin were not permanent, that its effects were uncertain, and that in some cases, instead of curing the disease it led to its increased activity, and early death.

Tuberculin has certainly not fulfilled the expectations that were formed of it, and, as a therapeutic agent, it has fallen into disuse, but we need not on that account despair of still finding some other substance that will do what tuberculin has failed to do. There are reasonable grounds for anticipating that unless folly and fanaticism and ignorance are allowed to prevail all over Europe and put a stop to experiments on living animals, we shall yet discover some agent that will infallibly control tubercular disease, that will follow up the tubercle bacillus like a sleuth-hound through the tissues and exterminate it, wherever it may be. It seems all but certain that in the antitoxin of Tizzoni and Cattani we have secured a substance that prevents the fatal development of tetanus or lock-jaw, or cures it. It seems highly probable that in the antitoxin of Behring, Roux, and Kitasato, we have had put in our hands a weapon which will enable us to reduce enormously the mortality from diphtheria. I had described to me lately two desperate cases of tetanus, in which the action of antitoxin was almost miraculous, saving the patients even at the eleventh hour, and indeed the medical journals just now teem with such cases and with cases in which the injection of a few drops of serum has compelled that bacterial thug, diphtheria, to slacken its strangling grip. It is not, therefore, extravagant to hope that an equally potent antidote to tubercle will one of these days be revealed to us.

Potent antidotes to tubercle are, indeed, being suggested from time to time. Within the last month Dr. Seymour Taylor has made a preliminary announcement that he has secured most satisfactory results in the treatment of consumption with aniline, which destroys low organisms, and with which the tissues may be safely saturated to such a degree that they are dyed red like a cotton or woollen fabric; while Dr. Viquerat, of Geneva, has published abroad his discovery that that long-suffering, much derided, but always dignified animal, the ass, affords in the serum of its blood a sure remedy for tuberculosis.

Great prominence having been given to Dr. Viquerat's alleged discovery by a paragraph in *The Times*, which reported that twenty-five out of twenty-seven patients suffering from consumption in the second and third degree, who had been given up by their physicians as lost, were cured by it, I thought it worth while to make some inquiries regarding it, and enlisted the services of my friend Dr. Arthur Gamgee, of Lausanne, eminent alike as a physiologist and practical physician, than whom there is no one more competent to investigate such a matter.

Dr. Gamgee visited Dr. Viquerat's laboratory at Moudon on the 19th instant, and spent several hours in listening to his explanations and in examining his apparatus and records, and while acknowledging his courtesy and candour, he has no hesitation in arriving at the conclusion that his statements as to the curative effects of the serum of the blood of the ass in consumption are as yet unsupported by trustworthy scientific evidence.

This is not, I believe, the first cure for consumption that Dr. Viquerat has introduced to the notice of his profession and the public, but there is, as Dr. Gamgee points out, nothing inherently improbable in his statements. On the contrary, the splendid results, just referred to, which have followed the use of the antitoxin of Tizzoni and Cattani in tetanus, and the promising observations that have been made by Behring, Kitasato, and Roux on a similarly prepared agent in diphtheria, predispose us to believe that the blood serum of an animal rendered immune to tubercle might modify or arrest the progress of tubercular disease in human beings. But, unfortunaely, Dr. Viquerat does not seem to have advanced much beyond the stage of "no inherent improbability" in his preconceived notion. He is not able to adduce proofs of his allegations that will satisfy anyone who is not dominated by a preconceived notion, and there is certainly a large measure of inherent and ascititious improbability in some of the observations he quotes in corroboration of his views.

Dr. Gamgee found in Dr. Viquerat's laboratory an entire absence of that nicety and precision that are essential for accurate results in bacteriological research, and he noticed in some of his processes a crudity which is suggestive not merely of error but of danger. The blood of the ass, for example, from which the serum is prepared is obtained by bleeding with an ordinary veterinary surgeon's fleam, and it is received in a large vessel which is placed over ice for 24 hours, when the serum is separated and has added to it 0·5 to 0·75 per cent. of carbolic acid, after which it is ready for use. As Dr. Gamgee remarks, this process affords not the slightest guarantee that the serum remains sterile, and there must certainly be great risk in using it on the human subject.

Dr. Gamgee gathered that until quite recently Dr. Viquerat used for his injections the blood serum of the ass pure and simple from animals which had undergone no previous preparation. At present, however, he uses the serum from an ass that, not less than six weeks or more than three months previously, has been subjected to an intra-venous injection of a bouillon culture of the tubercle bacillus and to a subcutaneous injection of the same. He asserts that as a result of these injections the donkey becomes temporarily tubercular, and that if examined between the fifteenth and thirtieth days the lungs are found full of miliary tubercles. This tuberculisation of the donkey, according to Dr. Viquerat, which clears up in from the thirtieth to the fortieth day, is free from danger and unaccompanied by fever, and is marked only by an enormous increase of appetite. But for all these observations of Dr. Viquerat there is no independent testimony, nor is he able himself to supply any exact data, or anything beyond meagre assertions and general statements. Dr. Gamgee could obtain no information as to the number of animals experimented on, and of course a very large number of experiments would be required to establish some of Dr. Viquerat's conclusions, but he discovered that during the last three months Dr. Viquerat has only had one ass to furnish him with all the serum used in his therapeutical work.

The results of Dr. Viquerat's treatment of tubercular affections are set forth in a short report by a medical man who only attaches his initials to it, but who is, it may be inferred from the infallibility of his style, a very young man. The report contains a list of twenty-five cases, but an examination of the list reveals that there is no guarantee whatever for the correctness of diagnosis in these cases. Taking the only cases that are beyond the reach of gross error—cases in the third stage of phthisis, and with cavities, we find that there were seven such cases treated. Of these one was cured! Of the remaining six one died, two admittedly had not improved and were obviously worse; while the other three are still under treatment and are said to be somewhat better. It is to be remembered that

Dr. Viquerat's experiments were begun in February last, and that his treatment of consumption has been going on for only a few months. That treatment, even on his own showing, is not satisfactory.

It is announced that an institute is about to be founded at Geneva for the treatment of tuberculosis by Dr. Viquerat's method. It is to be feared that credulous and despairing consumptive patients, trusting to exaggerated accounts of its success, will flock there only to incur disappointment, and it seems important, therefore, that the true nature of that treatment should be made known, and that it should be subjected to impartial criticism.

But even while buoyed up by the hope of finding a trustworthy antidote to tubercle we are not in the meantime justified in sitting with our hands crossed waiting for the discovery of a specific against it. We have as yet no cure, but we have even now means at our disposal which, under existing circumstances, will enable us, if properly employed, greatly to circumscribe the ravages of tubercular disease, and it is towards these presently available means of prevention that I now wish to draw your attention.

In their widest sense these means embrace the whole of hygiene, for whatever makes men, women, and children, healthy at the same time fortifies them against the attacks of their tubercular enemy. All sanitary improvements, therefore, tend to reduce the mortality from tubercle, and it can be shown that there has been a diminution in the number of deaths caused by certain forms of tubercular disease owing to ameliorations in the dwellings and habits of life of our people.

Sir George Buchanan has given us grounds for believing that a damp wet soil is very conducive to the prevalence of consumption in the population living on it, and has indeed shown that in certain counties in England there is a relation between the distribution of consumption and the geological formation; the consumptive death-rate being high where the ground is moist and of a character to hold water, and low where it is dry and of a character to let water run readily away. Well, there can be no doubt that drainage, both in agricultural districts and towns, has been carried out most extensively in this country during the last forty years, and there can be no doubt that during the same period there has been a steady fall in the mortality from consumption. In 1852 consumption caused 50,594 deaths, or at the rate of 2,851 deaths per million of the population living, whereas in 1892 it caused only 43,323 deaths, or at the rate of 1,468 per million living; and the noteworthy fact is this, that the diminished fatality from consumption has in the towns almost invariably followed the adoption of a system of main sewers and of house drainage with drying of the soil. The best drained towns on the driest soils are those that are freest from consumption, the worst drained on the wettest soils are those on which it still keeps the tightest hold; and the moral is that dampness in any town or dwelling is an invitation to the tubercle bacillus to come in, while dryness is a notice to it to pass on elsewhere.

The more rational feeding of infants in recent years has, no doubt, reduced the mortality from consumption of the bowels; and I might, indeed, go on enumerating to you all the modern sanitary advances on which we pride ourselves, and indicating how they have all influenced, more or less, the prevalence of tubercular disease amongst us, having done so by their beneficial effects on general health; for I want to emphasize the truth, already referred to, that perfectly healthy people are never successfully attacked by the tubercle bacillus.

But perhaps that statement may seem to some of you inconsistent with the other statement just made, that the tubercle bacillus is really a virus or poison acting upon the system. A sufficient dose of strychnia, you may say, will kill a man whether he be healthy or unhealthy. Why should not a sufficient dose of tubercle bacillus do the same? And the answer to that interrogation is that the tubercle bacillus is never received in a sufficient but always in an infinitesimal dose, and that, not being an inert substance, but a living organism, it manufactures its poison, and in ever-increasing quantity, after it has got possession of its victims. And there is a further answer to that interrogation, which is to this effect: that the tubercle bacillus never succeeds in invading the system without a struggle, and that the forces that oppose its invasion are much stronger in healthy than in unhealthy individuals. Extraordinary though it may sound, it is veritably correct that there are in the animal economy what we may call military as well as industrial cells, a standing army, or at any rate a volunteer corps, charged with the defence of the organism. The military cells—white corpuscles of the blood and connective tissue cells—are of two kinds, large and small, infantry and cavalry, and they instantly muster in force whenever any infective bacilli attempt to effect a landing in the tissues, and then a battle royal ensues. The small cells, the infantry, advance first and throw out a secretion which acts injuriously on the invading bacilli and cripples them, and then they come to close quarters with these enfeebled bacilli and eat them up and digest them; and after that the large cells, the cavalry, appear on the scene and eat up what remains of the bacilli and, I regret to add, very often eat up their own infantry into the bargain. Of course the victory is not always with the animal cells. The invading bacilli or fungi throw out their poison, which may stupify or kill the cells; they defeat, or overpower, or slip past them, and entrench themselves in some favourable spot from which they make sudden sorties, or where they may long lie inactive, waiting to renew hostilities at any moment of constitutional embarrassment or weakness. The outcome of the contest depends on the infective force of the bacilli on the one hand and on the vitality of the cells on the other, and the vitality of the cells depends on the state of health of the body to which they belong, and hence it is that healthy people can resist infective bacilli when weakly people succumb to them.

This is no fancy picture I have drawn, but a literal description of what takes place when tubercle bacilli effect a lodgment in the throat or lungs or on any mucous membrane, or when they are inoculated into a wound; and how vast the forces engaged in the campaign in the case of a tubercular invasion are, may be inferred from the computation that a phthisical patient will often expectorate twenty million bacilli in twenty-four hours. I venture to affirm that there is not one of us in this room who has not at some time or other been attacked by tubercle bacilli, for they are always about; but, happily, we are in good health at the time, our defensive tissue cells were vigorous and vigilant, and so we defied the intruder; we resisted the arch-enemy of mankind and he fled from us. Had we been worn out or debilitated there might have been another tale to tell. And it is not only at the first onslaught of the tubercle bacillus, but at every step in its advance—should it have gained a foothold in the body—that this struggle between it and the tissue cells is carried on; inch by inch its progress is disputed, and one of the grand principles in the treatment of consumption is to restore, if possible, to general health, and so strengthen the hands of the defending cells. Whatever improves the nutrition of the tissues retards the disease, and if the tissues can be brought back to a certain standard of health, it is checked and routed altogether. Whatever lowers the strength and interferes with nutrition promotes the conquering career of the bacillus.

You will now understand why a state of robust health is the best protection against tubercle, and how all sanitary precautions may be regarded as measures for its prevention.

About such general preventive measures, however, I do not propose to say more, but will occupy what time you will still spare me in pointing out some special protective measures, and these I shall consider in connection with the chief channels by which the tubercle bacillus invades the system, that is to say in connection with (1) hereditary transmission, (2) inhalation with air, (3) ingestion with food, and (4) direct inoculation.

As to the first of these, hereditary transmission, it is perhaps scarcely justifiable to speak of it as a channel of invasion of tubercle, for while believing that a tubercular mother may in rare instances communicate tubercular disease to her unborn offspring, we are not entitled to assert that tubercle bacilli or their spores are ever directly handed down from the parent of either sex to the infant in such a manner as to remain latent in its tissues at birth, to become active, as scrofulous glands in childhood, or as consumption in youth. Several eminent authorities think that this is so, but it is possible to find an explanation of the hereditary character of tubercle in another way. . That hereditary character is indisputable and is within the knowledge of each of you. You all know consumptive families in which there have been several instances of the disease in the same generation or in successive generations, and, allowing for the chances of simultaneous infection in persons living under precisely the same circumstances, there is still an ample margin of proof that the members of certain families, even when widely scattered, are specially liable to this disease, and that it clings to certain lines of descent as tenaciously as do peculiarities of the features of the face, or of the physical configuration. We have, indeed, come to recognise certain external appearances as indicating a phthisical or consumptive habit.

But the consumptive habit and special liability to consumption may depend on the hereditary transmission, not of the bacillus, but of a constitution of body favourable to its reception and growth. We know as regards the seeds of vegetables that they will only germinate and grow in the soils to which they are specially adapted, and the same is, in all likelihood, true of seeds of bacilli. Especially is this likely to be true of the seeds of the tubercle bacillus, which is a very fastidious member of its tribe. In artificial cultures, outside the body, there are only a few media in which it will thrive, and in using it for inoculation it has been found that there are certain species of animals that altogether resist its action, and that even in the same species there are individuals much more refractory to its action than others. It can be readily understood, therefore, that human beings who vary so much in temperament, that is to say in tissue states, vary also in their susceptibility to tubercle, and that there are certain types of them which afford in their tissues a soil particularly congenial to the bacillus. In them it takes root and spreads luxuriantly. The existence of tubercle in any individual affords a presumption that he or she is of that type; the existence of it in two or three members of one family affords proof that that family is hereditarily predisposed to tubercular disease.

And the lesson to be drawn from all this in prevention is that no human being actually affected by tubercular disease ought to marry on any pretext whatever, and that every man and woman should reflect well before marrying into a family in which a strongly declared tubercular tendency exists. In the first case the penalties are certain; in the second they are highly probable; and these penalties are of such a nature that a responsible human being may well pause before incurring them himself or inflicting them on others. I trust at no distant day public opinion will pronounce it not merely imprudent but flagitious for anyone on whom the plague of tubercle has fallen to marry or be given in marriage, and will condemn still more unsparingly the healthy partner in such a transaction, who, without the excuse of powers weakened by a morbid taint, sells not himself but his progeny to the arch-enemy of mankind. I trust also that at no distant date pure blood will be esteemed more highly than blue blood, and that the existence of tubercle in any family will be regarded as a bar-sinister on its escutcheon. Thus may moral forces operate for the prevention of tubercular disease.

The second channel of transmission of tubercle which I have mentioned is by inhalation, and is perhaps the most important of any, for I include under it direct infection from person to person, and the inspiration of tubercle bacilli or their spores floating in the air, alone or attached to motes in the sunbeam, and in connection with this channel there are valuable preventive measures to suggest.

Direct infection has been called in question, and the strongest argument against it has been founded on the statistics of Dr. Theodore Williams, which show that the nurses and medical staff of the Consumptive Hospital at Brompton, who are of course constantly in contact with tuberculous patients, are not more frequently affected by tubercular disease than members of the general community not so exposed; but this is probably to be accounted for by the state of high health in which these nurses and medical officers are maintained. Carefully selected in the first instance, at least as regards the nurses, for no one with tubercular tendencies would be engaged as a nurse, they are well housed and fed, and abundantly provided with fresh air and exercise, and are kept in that sound condition in which their tissues are well able to repel bacillary attacks. And on the other hand, the evidence in favour of the propagation of tubercle by direct infection is already sufficient to be convincing, and is always increasing in volume. This view has been long held in Italy and Spain, and is gradually obtaining acceptance amongst ourselves. The often observed contemporaneous or rapidly successive explosions of tubercular disease in a number of members of the same household, related or not, and amongst the inmates of public institutions, suggest infection, which is again made probable by the numerous recorded cases in which consumption has been contracted by a husband from a wife, or *vice versâ*, particularly when they have been living together in a confined space, as for example, in the cabin of a ship on a voyage to or from India. The contagiousness of tubercle is, I think, demonstrated by cases like the following:—

Mrs. R., aged 48, a dressmaker living in a rather lonely cottage at C., in Bedfordshire, had three apprentices, young girls of from 17 to 19 years of age, not related, and from three adjoining villages, who took it in turn to remain in the house and sleep with her, each one for a week at a time. During their apprenticeship Mrs. R. was taken with consumption from which she died. In less than two years afterwards all three apprentices died of consumption, although in the family history of not one of them did any trace of it occur.

The presence of tubercle bacilli and their spores in the air breathed by consumptive patients, floating independently or buoyed up by particles of dust, is now indisputable. Dr. Williams hung up glass slides smeared with glycerine in the ventilating shafts of the Brompton Hospital, and shortly found tubercle bacilli adhering to the glycerine; and Dr. Cornet, by elaborate experiments, conducted in the rooms of private consumptive patients and in hospitals, has shown that tubercle bacilli are expired by consumptive patients, in small numbers, and that they and their spores, which remember are very indestructible, and will retain their vitality even when dried, are given off in clouds from the handkerchiefs and bed-linen of consumptive patients, and from the floors or walls of the rooms they inhabit, if they are not scrupulously cleanly in their ways, from any place or thing, in short, with which their expectoration has come in contact. Cornet has further shown that tubercle bacilli may be caught in open spaces and in the air of streets and squares where tubercular persons are present, and in all these cases he has shown that the dust collected when inoculated into animals, sets up tubercular disease. Klein has shown that guinea-pigs become tubercular when finely divided tubercular matter is diffused by a spray producer in the air of their hutches, and he has succeeded in communicating tubercle to these animals by keeping them for a time in cages in the ventilation extraction shaft at the Brompton Hospital, through which the foul air from the wards passes. And quite recently M. Straus has communicated to the Académie de Médécine in Paris a very instructive observation. By means of little plugs of cotton-wool, the dust and mucus from the nasal orifices of twenty-nine healthy nurses and medical students, serving in the wards of hospitals containing consumptive patients, were collected, and solutions prepared from these were injected into twenty-nine guinea-pigs, of which nine manifested tubercular disease within a month. There can no longer be any doubt that the air of apartments occupied by consumptive patients is loaded with virulent dust, that the germs of tubercle exist in the atmosphere of all populous districts, and that the inhalation of the dried virus floating in the air is one of the commonest ways of the propagation of the disease.

Now seeing that we are thus surrounded by a cloud of witnesses of a very undesirable kind, who will swear away our lives if they can, seeing that the principle of death lurks in the very vital air we breathe, what must we do to be saved? What preventive measures does our new knowledge propose to us? Clearly, first of all, we must henceforth regard consumption as a contagious disease like small-pox, not of course as rapidly and conspicuously contagious, but slowly and insidiously so, and we must in some measure secure isolation for those suffering from it. It is not proposed to make our consumptives like lepers, a class apart, but assuredly special public hospitals, supplied with every possible appliance for their comfort and treatment, should be provided for them—hospitals in which they should not mix with patients suffering from other diseases, and in which the walls and floors of wards and rooms should be tiled or cemented throughout, so that they may be periodically subjected to thorough washing and cleansing; and assuredly in private homes consumptives should invariably occupy separate rooms. It is culpable to allow them to sleep in the same rooms with healthy people, and especially with children, and their presence in places of public assembly or entertainment is decidedly hazardous. Within the last three months the authorities at Toronto have set an example worthy of imitation, by upholding the Medical Officer of Health in prohibiting the attendance at a public school of a child affected by consumptive disease. In Florence it has long been the practice that, when anyone dies of consumption in a house, the bed is entirely destroyed, and all the clothes of the deceased, while the room is fumigated and shut up for a time. But we should not postpone our precautions till death has taken place, but concentrate our attention upon the receptacles of that expectoration which is known to be the chief vehicle of infection. Pocket-handkerchiefs and bed and body linen used by consumptives must be carefully sterilised by hot air or steam, and powerful germicidal agents, and expectoration should be invariably received in spittoons containing a strong disinfectant. But our enlarged acquaintance with the possibilities of inhalation of the tubercle bacillus not only suggests isolation of the sick and disinfection of their surroundings, but increases the obligation which has all along rested on us to insure good ventilation of our houses and public buildings. Where air stagnates the tubercle bacilli accumulate, and are reinforced; where it is in brisk movement they are scattered abroad and disarmed. Consumption is most common in cities and in their most densely populated parts, and is rarest in purely rural districts. In London the deaths from consumption were, during the ten years 1881 to 1890, at the rate of 2·08 per thousand living, and in Lancashire they were at the rate of 1·95, whereas in the purely rural counties of Somersetshire and Dorsetshire the rates were only 1·35 and 1·39 respectively. The history of public institutions of many kinds brings home to us the connection between defective ventilation and high phthisis mortality. Previous to the report of the Royal Commission on the sanitary condition of the army in 1858 our barracks were overcrowded and destitute of fresh air, and the mortality from consumption amongst our troops was terrific. In the ten years 1837 to 1846 it reached 11·9 per thousand of strength. But after the report of that Commission, the allowance of air-space per man was considerably increased and ventilation was attended to, and the mortality from consumption immediately and rapidly declined; it fell in 1888 to 1·2 per thousand of strength. And similar experiences might be quoted from the histories of prisons, schools, asylums, religious houses, in all of which the mortality from consumption in the past has been excessive, sometimes appalling. In Austrian prisons consumption was at one time responsible for 61 per cent. of the whole mortality, while it was only causing 14 per cent. of the mortality outside the prison. In many such establishments the tubercular death-rate is still far too high, but in most of them it has fallen and is falling. In such establishments of course many factors, such as meagre and monotonous diet, insufficient exercise and depressing emotions, have contributed, with the want of fresh air, to swell the mortality from tubercle by lowering the general health and so allowing an opportunity to the ever-present bacillus to steal a march on the constitution; but it is demonstrable that the impurity of the atmosphere in the living apartments, and especially in the sleeping rooms, has been mainly to blame for their evil reputation as hot-beds of consumption.

Then ventilation is not less necessary for the prevention of tubercular diseases in mines, factories and workshops, than it is in public institutions. The loading of their atmosphere with particular kinds of dust, appertaining to the trades carried on in them, is a prolific cause of tubercle in the lungs, and we have come to speak of miners' and knife grinders' and potters' consumption. The dust in such cases penetrates the lungs, and by its hardness and angularity wounds the mucous membrane, setting up irritation and catarrh, and creating that raw surface on which the tubercle bacillus loves to fasten and batten.

The ventilation of mines, factories and workshops is a matter for factory inspectors who ought to, and no doubt do, give it their most zealous attention, and we may hope that their exertions will ultimately, to a great extent, banish dust from these places, or enable it to be dealt with in such a way as to make it innocuous, but the ventilation of the home is the business of the individual man as well as of public authorities, and these must co-operate if it is to be satisfactory.

In humble homes there is still, it is to be feared, too little appreciation of fresh air, too much apprehension of an open window; and when driving through a dingy, stifling working-class quarter of a big town the other day, and seeing the walls placarded with bills "Register! Register! Register!" it occurred to me that a much more valuable exhortation would have been "Ventilate! Ventilate! Ventilate!" But it must be admitted that even with a desire to ventilate properly, it is in many workman's homes impracticable to do so. To open the windows is to admit foul odours, and the construction of the house absolutely prevents any through current of air. Nothing can interfere more with free ventilation than that abominable system of economical construction, still tolerated in many towns, and known as back-to-back houses. Dr. Tatham, the Superintendent of Statistics to the Registrar-General's Department, showed that in certain courts and streets in Salford, consisting of back-to-back houses, tubercular disease was much more common than in other parts of the same town; that this disease reappeared in the same houses in these courts and streets again and again, and that the proportion of deaths from tubercular disease in the different districts of Salford increased in proportion to the number of back-to-back houses they contained. Dr. Herbert Jones has confirmed Dr. Tatham's conclusions, and has shown that in Saltaire and Ripley, in Yorkshire, the deaths from consumption are at the rate of

2·3 per annum to each 1000 living in houses with through ventilation, and at the rate of 3·4 in back-to-back houses. And Dr. Hope, your own able Medical Officer of Health in this city, has revealed that in certain streets of insanitary houses in Liverpool, happily about to be demolished if they have not already been so, the death-rate has mounted to 61, 67, and even 71 per 1000, that is to say more than three times the average rate for England. And in the production of these enormous death-rates tubercular diseases have played a prominent part. After reading Dr. Hope's description of the houses in which these death-rates prevailed, the wonder is not that so many persons died in them, but that anybody remained alive. He describes 578 houses, each consisting of three rooms, one over another and without any intermediate landing, so that the same atmosphere pervaded the entire house. They were back-to-back and side-to-side, with no separate sanitary accommodation; they had bulging walls, dilapidated window sills, crumbling mortar, rotten wood-work, and walls and ceilings grimy and saturated with foul-smelling exhalations.

Is it not high time that such pest-ridden habitations should be swept away? Is it not high time that the working classes should insist on local and municipal authorities using all the powers they possess in dealing with crowded and insanitary areas, and if these powers are not sufficient, demanding more? The prevention of tubercular and of many other diseases, the health and happiness of the rising generation, the industrial supremacy and the morality of the nation are at stake in this question. The Artizans' Dwelling Act of 1890, which enables the ground to be cleared in towns and a better class of dwellings to be provided for our toiling masses, is, it seems to me, one of the most sensible Acts passed by Parliament in our generation, and I trust that a pregnant suggestion thrown out by Mr. Chamberlain, that great and enlightened statesman, that the principle of the Irish Land Act should be applied in English cities, and the working classes be enabled, by the assistance of the credit of the State, to become the owners of their own dwellings, will not be lost sight of. "Own" is a sweet sauce to eat sour cherries with; it would, I believe, prove a potent antiseptic for the conversion of dirty, insanitary hovels into clean and wholesome human abodes. The expense to the ratepayers of such operations would, no doubt, be great, but a rich return would be obtained if the money were judiciously spent, and even the most affluent citizens living in the best parts of the town would benefit indirectly in the betterment of the health of their families. You cannot touch pitch without being defiled, and you can scarcely live amongst disease without being tainted.

The town that is healthiest and most contented is the safest to live in, and we are all interested in the prevention of tubercular disease.

The problem of the housing of the working classes in towns is no doubt difficult of solution; and is day by day becoming more complex, owing to the rapid growth of towns and the tendency of population to gather in them. The cry is still, they come. From ploughed fields and pastoral valleys, from ruddy hamlets set in bosky green, and brine-stained villages on many a breezy shore, a constant stream of men, women and children, driven by hunger, or drawn by the flare of the gas-lamp, flows into our narrow streets and noisome slums. To set against this centripetal stream we have a comparatively small centrifugal one of well-to-do people, who carry on their business in towns and make their homes in the country; and it may be Utopian, but I hope to see a very large increase of this centrifugal stream, and the provision of suburban homes for the working classes—with facilities for transit to and from them—homes in which they may enjoy fresh air and relaxation. A little cottage in the country with a curtilage around it is worth far more in all sanitary respects than a three-storey house with a brass door-knocker in a street. Garden allotments are very good things in their way, but it is a drawback to have to trudge to and from them, and it is not as refreshing as it might be to delve a patch in a row of patches—a sort of treadmill horticulture; while it is certain that every man of Teutonic origin has an ineradicable partiality for a hedge of his own. A cottage with a little garden around it is what a working man should aim at as the best sort of sanitary dwelling. "Now and then," says Ruskin, "a wearied king or a tormented slave found out where the true kingdoms of the world were, and possessed himself in a furrow or two of garden ground of a truly infinite dominion." And so many a time and oft henceforth I trust wearied workmen and their school-worried children will find in a few furrows around the cottage home new interests all the year round, yielding mental rest and infusing a little poetry into dull and prosaic lives, and also that exercise in the open air which is incontestably preventive of tubercular disease. It has been shown that in proportion as the male and female populations are severally attracted to indoor branches of industry, in such proportion, other things being equal, their respective death-rates by lung diseases are increased. An outdoor life wards off consumption and sometimes cures it, and the dangers of inhalation of tubercle are diminished where there is active movement under the blue sky. And in this connection the mode of life of our school children demands some attention in these days. It will not be disputed that children of school age in our elementary schools, who are kept at work for five or six hours a day, are much more inactive than they would be if they were not at school, and are breathing more confined air than they would do if left to themselves. They are standing still, or seated, or bending over desks. And their respiration is therefore shallow, not deep and lung-expanding as it would be if they were unrestrainedly indulging in the restless movements and gambols that are characteristic of their period of life. And wherever the respiration is shallow, what we call metabolism, or the building up, breaking down, and renewal of the tissues of the body is interfered with; and wherever metabolism is interfered with the desire for food or appetite fails, and thus it is that schooling, which is now universal, is accompanied by conditions favourable to tubercular development and must be safeguarded by physical education, if it is not to induce wide-spread degeneration. All the wisdom of the Egyptians, and of the sixth standard to boot, will avail little to the boy or girl whom tubercle has once marked for its own. Pray believe, then, in the case of your children, that the merry-go-round is not mere juvenile dissipation, that a day in the country is a bracing tonic, and that dancing is a not less useful branch of education than vulgar fractions.

Monkeys in confinement die of tuberculosis in large numbers, and it would seem therefore that the monkey-house in the Zoological Gardens, with its heated atmosphere, is scarcely a safe place of amusement for delicate children.

I have been speaking of air-borne tubercular disease—of its invasion of the organism by inhalation. Let me now briefly advert to its propagation by ingestion, or introduction into the system by food and drink, and to the preventive measures which suggest themselves in that connection.

It is possible that the tubercle bacillus may be swallowed in water. It has been lately stated by Fernandez that it was found in the water of a ditch, and that a child contracted tuberculosis through drinking it; but we know no facts which warrant us in believing that this channel of invasion—a favourite one of the typhoid and cholera bacilli—is frequently adopted by the tubercle bacillus. Bad water deteriorates health and thus encourages tuberculosis, and its purification by filtration or other means is preventive of tuberculosis by its influence on general health; but there are no special measures to be recommended in the treatment of water aimed at the tubercle bacillus.

Very different, however, is the case with milk which is probably one of the most frequent vehicles of tubercular infection in young children, and one-third of all young children dying in our hospitals are killed by tubercular disease. Long ago it was remarked that in advanced cases of consumption there is often ulceration of the bowels of a tubercular nature. This was not seen in the early course of the malady, but towards its close, and it was therefore inferred that it was due to the swallowing of some of the expectoration from the lungs, which, passing through a stomach of enfeebled power undigested, set up a secondary tubercular crop in the intestines. But in infants tubercular ulceration of the bowels often occurs without any previous tubercular disease of the lungs, and in them it seemed probable that the tubercular virus was somehow introduced directly into the alimentary canal. This view has been substantiated by many experiments and observations, and it has been made clear that milk is the most frequent source of tubercular infection in young children, and that in this case the bacillus is not, as in typhoid fever, added to the milk in water, but is in the milk as it comes from the cow, for cows are very liable to tubercular disease, which in them very often affects the udder. Where cows are tubercular the bacillus has been found in large quantities in the milk ducts and also in the milk after it has been drawn, and with the bacilli obtained from cows' milk successful inoculation has been carried out in animals. Taking the milk from tuberculous cows, Gerlach and Chauveau have fed numbers of young pigs and other animals on it, and have shown that in a large proportion of them there supervened tubercular ulceration in the alimentary canal. That the same thing occurs in children Dr. Sims Woodhead has made evident. He has statistically established that abdominal tuberculosis, tubercular disease of the intestine or mesenteric glands, is rare in infants under one year old, and that in the second year of life it is exceedingly common; and he has connected these results with the facts that during the first year the child is generally suckled by its mother and that it is towards the end of the first year that cows' milk enters into its dietary. Tubercular disease is, as I have said, very common in cows, especially in cows stall-fed and kept in towns, and it is likely, therefore, that few town children who get milk escape a dose of the bacillus now and then. That it is not more widely productive of disease than it is may be attributed to the facts that a certain concentration of tubercle bacilli is necessary in order that disease may be set up (they can only effect a landing when they attack in force), and that when a child is healthy and is freely secreting gastric juice in its stomach, and has its mucous membranes in a sound state, the intruding bacilli are baffled or destroyed. It is only when tissue weakness is present, due to debility, constitutional or induced by rickets or attacks of acute specific diseases such as measles or whooping-cough, or by insanitary surroundings, or where irritation or abrasion of the surface of the alimentary canal, due to unsuitable food or other cause exists, that milk-borne tubercle bacilli are able to create disease. These contributory conditions, however, are often present in children in these days, and there can be little question that it is to the advantage taken of the facilities they offer by the tubercle bacilli contained in cows' milk, that we must trace many of the cases of miliary tubercle we encounter in the children of parents with no tubercular tendencies. Dr. Walter Carr has shown cause for believing that the primary focus of tubercular disease even in young children, is in the thoracic glands in a far larger proportion of cases than we have hitherto supposed, but even his statistics still leave a heavy responsibility on cows' milk and point to the intestinal canal as a frequent portal of entrance of the tubercle bacilli during the first five years of life and to the mesenteric glands as their first rallying point.

What must we do then to prevent the dissemination of tubercular disease by milk? Absolutely forbid the suckling of her child by a tuberculous mother, make it penal for dealers to sell the milk of cows affected by tubercle, and insure the efficient inspection of dairy farms. Already steps in this direction have been taken in several places. Tuberculosis in cattle is as rife in America as it is in Europe, and its prevalence in New York has induced the Legislature there to appoint three Inspectors whose duty it is to examine the herds in each county, and order the slaughter of all affected animals. 20,000 cattle were examined in 1893, and 686 were found infected and killed. Similar precautions have been taken by one of the great milk supply associations in Denmark, who have all their cattle subjected to veterinary inspection once a fortnight; such frequent examination being necessary, as tubercular disease in cattle is often very rapidly developed. An ordinary physical examination generally leads to the detection of the disease, but it is possible that it may be overlooked when it is of recent origin or deep-seated, and it is satisfactory, therefore, that we have now in our possession a sure, simple, and scientific test in Koch's tuberculin, which I have before mentioned to you, and which if untrustworthy in treatment is invaluable in diagnosis. When tuberculin is injected into an animal it immediately raises the temperature if tubercle be present, but has no effect on body heat if the animal be healthy; and advantage has been taken of this action of tuberculin to determine the presence or absence of tubercle in cattle. At the Central Experimental Farm at Ottawa, in Canada, some most instructive experiments have been carried out during the last two years. Fifty-four animals in all have been tested. Of these twenty-six gave the characteristic rise in temperature, 3 to 5 degrees, and in every one of them, when slaughtered, tuberculosis was discovered, while in the other twenty-eight there was no reaction, and they, when slaughtered, were found sound and healthy. It thus appears that we have now a sure and ready method of diagnosing tuberculosis in cattle, and it is believed that the general use of this means of detection, followed by prompt isolation, disinfection, and disposal of affected animals, will greatly diminish the prevalence of this dangerous malady.

But there is still another and almost infallible precaution against the propagation of tubercle by milk, a precaution that is within the reach of each of us, and that is the boiling of the milk. I confess it is to me astonishing that the acknowledged dangers that lurk in milk—dangers not only of a tubercular nature but of various kinds—have as yet received so little practical recognition in this country, for the precaution of boiling all milk given to infants or children, so as to destroy any bacilli or spores it may contain, is still the exception and not the rule in English households. Perhaps the day will come when it will be considered as reprehensible to partake of raw milk as it would be now to devour raw meat, and I am sure I shall not have appeared in vain on this platform this evening if I can persuade some of you who are heads of households, to lay it down as an inexorable rule henceforth that all milk used by your families shall be boiled for five minutes. You will perhaps tell me that the boiling of milk imparts to it a disagreeable flavour which makes it distasteful to children, but the answer to that objection is that it is only freshly boiled milk that has that flavour, and that milk set aside for a few hours after boiling, in a cool, airy place, almost entirely loses it.

I daresay some of you recollect the story of the two sinners who had to do penance by walking to a certain shrine with parched peas in their shoes. One of them went merrily ahead, accomplished his journey, and on his way back met his companion creeping along footsore and in pain and tribulation. Interrogated by that companion as to his wonderful celerity and ease in the performance of his task, he explained it by stating that before starting he had taken the liberty to boil his peas. Now, I would say to you, that if in the pilgrimage of life you would spin happily along, free from the suffering and tribulation that sickness in the household never fails to bring, you must not neglect to boil your milk, for boiling softens the hard heart of a cruel bacillus as effectually as it does that of a parched pea.

And with reference to this great domestic function of the boiling of milk, I would impress on you that it ought always to be carried out with the utmost strictness. If it be left to the cook, or the little handmaid, or the little sister, it is certain that it will be imperfectly done now and then, and it seems to me desirable that the mother should always prepare the milk with her own hands, and herself see to the dainty cleanliness of the utensils used.

The flesh as well as the milk of animals suffering from tuberculosis may communicate the disease to human beings. That the consumption of parts of a carcase actually tubercular and imperfectly cooked may convey it is undoubted, but there are differences of opinion as to whether the flesh or muscular substance can carry it when the disease is confined to certain viscera, such as the lungs or spleen. The juice of the muscle—raw, of course—of a cow suffering from tubercular disease of the pleura, has induced tubercle when injected into rabbits, and of twenty-two guinea pigs and rabbits fed on meat from the carcases of tubercular cattle—the meat being free from visible tubercle, and prepared with as much precaution as a butcher would use in the course of his trade—eighteen contracted tubercular disease. Notwithstanding the protection afforded by thorough roasting or boiling, I should prefer for my own part, pending the Report of the Royal Commission that is inquiring into the subject, not to touch the flesh of any animal affected by tubercle, even to the smallest extent, for visible nodules do not determine the distribution of the bacillus or its spores, and the blood and lymph streams carry these far and wide.

The comparative freedom of the Jewish race at all ages from tubercular disease—a remarkable and established fact—is in all probability, like their superior longevity and special exemption from, and liability to, certain other diseases, to be attributed mainly to their racial characteristics; but it must also, it seems reasonable, be traced in some degree to the rules as to their dietary laid down by that first great bacteriologist, Moses, and to the still stricter ordinances of the Talmud, as to the inspection of animals used as food. Among the maladies indicated in the Jewish code, as rendering an animal unclean and unfit for consumption, tuberculosis is clearly one; while the methods of examination prescribed, including insufflation of the lungs, are specially directed towards the detection of that malady. The Jewish restrictions are no doubt unduly severe, for in London they involve the rejection, on the average, of 40 per cent. of bullocks, 29 per cent. of calves, and 23 per cent. of sheep, whereas not more than 20 per cent. of adult cattle, and

1 per cent. of calves in Great Britain are tuberculous, and only a small percentage of rejections is due to other diseases; but they have certainly effectually excluded one source of danger from the food of the Jewish people, and it is to be hoped that the Report of the Royal Commission, already referred to, will recommend some further protection than now exists of Gentile food. The abolition of private slaughter houses in towns, the stringent supervision of public ones, and of meat markets, with skilled inspection, such as is provided in Berlin, of all doubtful carcases, are inevitable, and beyond these we may expect, from the protracted deliberations of the Commission, guidance at many difficult points, and a scheme for the ultimate stamping out of tuberculosis in cattle, with just compensation to owners.

It seems particularly important for us to ascertain to which breeds of cattle tuberculosis specially attaches itself; a little difference often means much in bacteriology. The brown Hanoverian rat sets anthrax at defiance, even when inoculated with the bacillus in large doses, but the white rat is very susceptible to it; and it is probable that different breeds of cattle differ greatly in their susceptibility to tuberculosis.

The danger of the communication of tubercle by animal food was, I notice, at the last annual meeting of The Sanitary Institute made the ground for an ingenious plea in favour of vegetarianism. It was argued that the prevalence of tuberculosis in man is due to the large degree in which flesh enters into his diet, and this argument was all very well, until it was pointed out that the animals from the flesh of which the tubercle is said to be derived are pure vegetarians, and that the carnivora that are not vegetarians are comparatively free from tubercular disease.

The fourth channel of invasion of tubercle which I have mentioned, namely by direct inoculation, may be briefly disposed of, for while tubercular disease can thus be experimentally communicated with the utmost certainty, it is only thus naturally conveyed, when lupus or tubercle of the skin follows the introduction of the bacilli into a scratch or cut, unless we include under it those cases in which the bacilli are directly planted in some crevice in the mucous membranes of the first lock of the alimentary canal, the buccal cavity or mouth, or in its lower outlet, the throat. In tubercular swellings of the glands of the neck, the bacilli gain ingress through the door opened for them by a decayed tooth, or by the unhealthy and congested state of the lining membrane of the mouth and throat, and especially of the tonsils, in the crypts and follicles of which, when enlarged, bacilli have been found ensconced, ready to bore their way to deeper structures. Bathing of the skin and cleansing of the mouth, regularly performed, and timely dentistry whenever needed, may therefore be regarded as preventive measures against tubercular disease. Decayed teeth must not be tolerated, swollen tonsils must not be left blocking up the throat, and even what are called "common colds" in children must not be neglected. Terribly, vexatiously exacting may seem the prophylaxis of tubercular disease, but the measures included in it are beneficial in warding off many other disease-enemies besides the tubercular one; and a faithful observance of them will really free life from some of its most oppressive burdens, and make its yoke easy and light.

There is just one other agent that may be employed for the prevention of tubercular disease that I wish to name to you. It is not connected either with inhalation or ingestion, or inoculation, but it is becoming of great significance, and it is *light*.

There has long existed, alike in East and West, a belief, not always, however, practically acted on—that light is salubrious and inimical to the spread of disease. But until quite recently this hygienic influence of light has been ascribed to the heating and drying effects of the sun's rays, and it is only to-day, as it were, that we have come to recognise the fact that light operates directly on the causes of disease, and that bacteria, not less than human beings, are liable to sunstroke. A few years ago Dr. Downes discovered that bacteria planted in meat broth, which multiply at an enormous rate when kept in the dark, at once cease to do so if exposed to intense sunshine, and since then, step by step, it has been established that the killing of bacteria by sunshine is due, not to any rise of temperature that accompanies it, not to the generation of any poison by decomposition of the nutrient fluid around, but to an immediate lethal effect of the sun's rays upon bacteria and their spores. Of most pathogenic bacteria it may now be said with strict accuracy that they "love darkness because their deeds are evil," and that they cannot abide the light.

The brilliant experiments of Professor Marshall Ward have demonstrated that the spores of certain bacilli, which may even be boiled for a few minutes without losing their germinating power, are killed outright by a bath of sunshine, and that bacilli which are not killed are greatly retarded in their growth under the same circumstances, and these experiments have demonstrated further that it is not all but only some of the rays in solar light—namely, the blue, and the blue-violet rays, that are concerned in the slaughter of the bacilli and their spores. The ultra-red rays, the red rays, the orange rays, the green rays, are harmless, but the blue and the blue-violet rays are injurious or fatal in their effects.

Taking a shallow glass dish, Professor Marshall Ward poured into it an ingeniously prepared jelly, which in a few minutes stiffened into a film containing about 5,000,000 invisible spores evenly distributed through it. The bottom of the dish was next covered by a zinc stencil plate, out of which a letter of the alphabet, say T, had been cut, and every other part of the dish being wrapped over with tin-foil and black paper so that no light could reach the film except what passed through the T-shaped opening in the stencil plate, it was exposed to the sun's rays for two or three hours. After this the wrappings and stencil plate were removed, and the dish was placed in an incubator where a temperature suitable to the germination of spores was maintained for from twenty-four to forty-eight hours. And then it was examined, and always with this result, that the spores imbedded in the parts of the gelatine sheltered from the light by the coverings were found to have germinated and sprouted into numerous colonies, making the gelatine opaque, whereas the spores in the T-shaped area exposed to the light had not germinated, because they were dead. The letter T was printed in the gelatine because the spores included in it had been killed by the light, and so had not produced colonies interfering with the clearness and transparency of the gelatine.

By further admirable experiments Professor Marshall Ward showed that it takes a bacillus in blue light the same time to grow 50 units of length that it takes one in red light to grow 1,200 units. He demonstrated that light acts as a retarding influence on the growth of the vegetative bacilli as well as injuriously on the germinating spores, and that in both cases it is the blue-violet rays which are effective. If these rays are sufficiently intense, or act for a sufficient length of time, they kill the organism without fail.

Now these experiments explain to us why it is so important that we should live in the light, and that our houses and streets should be inundated with sunshine; and they indicate that there is perhaps some truth in the popular notions that epidemics due to parasitic fungi most prevail in dull, heavy, cloudy weather, when the sun's light is to some extent cut off from the earth; and that there is special danger in night air. And these experiments bring home to us the value of light as an auxiliary in our conflict with this terrible tubercle bacillus, for Koch has taught us that it is destroyed by direct sunshine in a period varying from a few minutes to some hours, according to the thickness of the material in which it is suspended; and Drs. Ransome and Delepine, following in his footsteps, have proved that dried consumptive expectoration exposed to air and light entirely loses its virulence or power for evil in from two to seven days. Cultures were destroyed even by diffused daylight when kept in it from five to seven days, and it is clear, therefore, that sunlight beneficially purifies the air of the spores of the tubercle bacillus, with which in our great centres of population it is so often sprinkled, and that it ought to be admitted as freely as possible into our consumption hospitals and sick rooms. I am not without hope that sunlight may yet be used as a curative agent in tubercular disease. No doubt in the commonest forms of that disease, in consumption of the chest or bowels, in water on the brain, or in glandular affections, the tubercle bacillus is working in dark cavities where light never comes and cannot be conducted, but there is one form that attacks the skin that is very obstinate, produces shocking disfigurement and misery, and necessitates painful operations—I mean lupus—upon which sunlight may be brought to bear. I am not going to discuss the question whether the bacillus of lupus is identical with that of consumption—different opinions are held on that point; but at any rate lupus is a form of tuberculosis, and the bacilli of the two are so similar that we may assume that they are amenable to the same influences, and that light will be as pernicious to the one as it is to the other. And indeed I think we are not without evidence even now of the controlling effect of light on the lupus bacillus. Lupus is always an unsightly blemish, and so is invariably hidden from view, and most of the medicaments employed in its treatment, lotions and ointments and dressings, involve its being covered up and kept in the dark; but still as a consequence of its position on the surface of the body, and especially of its favourite sites being the face and hands, it gets more light than any other form of tubercle, and it is therefore interesting to note that as compared with tubercular disease elsewhere it is slow in its advance, and contains very few bacilli in the diseased structure that characterises it. I am informed on excellent authority that lupus is scarcely known, except as an imported disease in the High Alps, and we must bear in mind that intensity of the sunlight is one of the climatic conditions of those Alpine regions, which have become such favourite health resorts in cases of tubercle of the lungs. All the information we possess seems to encourage the hope that benefit and perhaps recovery may be secured in lupus—that wolf at the door that is gnawing the beauty and brightness out of so many young lives—by its systematic exposure, with and without operation, to sunlight or to blue and blue-violet rays.

But whether or not lupus may be thus successfully treated, there can be no doubt that in our warfare with tubercle generally, "light, kindly light," will help to lead us on to victory; and I would exhort the working men of Liverpool to demand for themselves and their children bright light not less than fresh air and pure water, and wholesome milk and meat. I am not going to suggest that we should all live in glass houses, but I am sure we should have big windows. I am sure that factories, workshops, and schoolrooms should be flooded with light. I am sure that working men should choose for themselves, when practicable, well-lighted dwellings, and that they should, through their municipal representatives, require that due regard be had to the free admission of light in all building operations in towns. It is deplorable to see how in some large towns, London amongst them, mansions and blocks of artizans' dwellings are being piled up to an enormous height, with no proportionate widening of the street, which is indeed converted, in some instances, into a sort of damp cellar—a street with no sunny side, sunk in perpetual and all-pervading gloom. Jedediah Morse, an old American geographer, described the town of Albany as "a city of one thousand houses and ten thousand inhabitants, all standing with their gable-ends to the street." The attitude attributed to the inhabitants seems unreasonable, but that of the houses is worthy of commendation: for a house with its gable-end to the street in the style of old Albany must have been begirt by light, and although in these days we can scarcely hope for such an arrangement, or even for houses up to the true sanitary standard, not exceeding two storeys in height, we may still insist on the maintenance of ample channels for light between our blocks of houses, and on the curtailment, as far as possible, of that great canopy of smoke that is densest over our busy hives of industry, but the fringes of which now hang over almost the whole of England—intercepting and enfeebling the solar rays that ought to cheer and invigorate us, and cleanse earth, air and water, of the perilous stuff that weighs upon the public health.

And there is one other point in connection with the usefulness of light in the prevention of tubercle to which I would allude, and it is this, that all articles of wearing apparel and bedding should after washing be dried in bright light. Water is not fatal, nay, it is not very injurious, to the tubercle bacillus, which has been known to retain its vitality when immersed in it for as long as 115 days, and therefore washing alone (unless boiling water has been used), unaided by exposure to light, can scarcely be trusted to disinfect the linen which has been used by tuberculous persons. It should be well soaked in boiling water, well scrubbed, well bleached in the open air, and so indeed should all clothing and bedding if they are to be thoroughly fresh and wholesome. The limitations of our climate and of our modern habits of life, however, to a great extent render such a procedure impracticable, and as a matter of fact a large proportion of the drying of clothes and linen in this country is carried on in darkness in steam-presses and closets, or in semi-darkness in back kitchens, cellars and lofts. This is largely the case in hospitals and institutions in which dark drying presses are in almost universal use, and it is to be remembered that in them tubercular disease is common. I would suggest that these drying presses should be no longer dark but roofed with white or blue and violet glass, or illuminated by the arc light, which is almost as efficacious as sunlight in the destruction of germs.

And now, ladies and gentlemen, I have finished what I have to say this evening about the prevention of tubercular disease. I know I have exhausted your patience, and I fear I have had to deal with a subject not very attractive or æsthetical. An eminent scientific friend of mine says that whenever he attends a lecture on bacilli he has a creeping sensation all over him and feels like a horrid old Stilton cheese, and if I have produced effects of that kind on any of you I can only apologetically remind you that The Sanitary Institute is obliged to deal with unsavoury topics, and that bacilli are not more objectionable than drains, which might, perhaps, have occupied your attention had I not been here. And on behalf of bacilli I would also remind you of the prediction of Lord Salisbury, that they and their kindred organisms, upon which the lives of millions of human beings depend, will for a generation to come figure more largely in the field of science than any other subject. Legions of bacilli brood over, infest, and grievously afflict this over-crowded City of Liverpool. I trust the working men of Liverpool will be "up and at 'em," and do their best to drive them into that outer darkness prepared for the arch-enemy of mankind and his angels.

CLOSING GENERAL MEETING OF THE CONGRESS.

SIR FRANCIS SHARP POWELL, BART., M.P., IN THE CHAIR.

REPORTS of the work done in the different Sections of the Congress, and the Resolutions passed, were read by the respective Secretaries, and the Resolutions were referred to the Council of the Institute for consideration.

Further awards since the opening of the Exhibition were reported.

Moved by Sir Thomas Crawford, K.C.B., M.D., Q.H.S., and resolved :—

"That the Sanitary Institute and Members of the Congress desire to express their most sincere thanks to the Right Hon. the Lord Mayor and the Lady Mayoress for the cordial manner in which the Congress has been received, and for the personal kindness and hospitality extended to the members."

Moved by Sir Charles Cameron, M.D., and resolved :—

"That the hearty thanks of The Sanitary Institute and of the Congress be presented to Principal Rendall, Professor Londini, and Professor Hele-Shaw, for their courtesy in placing at the disposal of the Congress the handsome and suitable buildings of the University College for the various meetings."

Moved by the Rt. Hon. The Earl of Haddington, and resolved:

"That the cordial thanks of The Sanitary Institute and Members of the Congress be given to the Local Committee and to the Local Secretaries for the successful arrangements made for the business of the Congress, and the entertainment of visitors to the City.

Moved by Mr. G. J. Symons, F.R.S., and resolved :—

"That the Local Committee be requested to convey to all those who so kindly received the members of the Congress at the various excursions, the sincere thanks of The Sanitary Institute and Members of the Congress, for the courtesy and hospitality extended."

Moved by the Rt. Hon. The Lord Mayor, and resolved :—

"That the cordial thanks of the Congress be hereby presented to Sir Francis Sharp Powell, Bart., M.P., for the interest and courtesy that he has displayed in presiding over the numerous meetings."

The numbers attending the Congress were as follows:—Delegates, 480; Members and Associates of the Institute, about 400; Associates of the Congress, 184; making a total attendance of over 1,000.

Delegates were appointed by the Russian Government, by 200 Sanitary Authorities, and by 25 Societies and Associations.

LIVERPOOL EXHIBITION.—AWARDS.

MEDALS.

Blackman Ventilating Co., 63, Fore Street, London, E.C.
Electric Steam and Water Ventilating Fans.

Boake, Roberts & Co., Stratford, London, E.
Liquid Sulphur Dioxide for Disinfecting Purposes.

Bovril, Limited, 30, Farringdon Street, London, E.C.
Bovril.

Brand & Co., 11, Little Stanhope Street, Mayfair, London, W.
Meat Preparations for Invalids.

Burroughs, Wellcome & Co., Snow Hill Buildings, London, E.C.
Improvements in Pharmaceutical Preparations.

Calvert, F. C., & Co., Bradford, Manchester.
Pure Carbolic Acid.

Carter, Alfred, Limited, 47, Holborn Viaduct, London, E.C.
Ambulance Litter.

Cliff, J., & **Sons**, Wortley, Leeds.
Cecil Porcelain Slop Sink.

Cliff, J., & **Sons**, Wortley, Leeds.
Imperial Porcelain Bath.

Crossley Bros., Limited, Openshaw, Manchester.
Crossley's Small Special High Speed Gas Engine.

Defries, J., & **Sons, Limited**, 147, Houndsditch, London, E.C.
Geneste Herscher Steam Disinfecting Apparatus.

Defries, J., & **Son**, 147, Houndsditch, London, E.C.
Pasteur Germ Filter.

Doulton & Co., Lambeth, London, S.E.
Metallo-Keramic Joint for Connecting Lead to Earthenware.

Fry, J. S., & **Sons**, Union Street, Bristol.
Pure Cocoa.

General Electric Co., **Limited**, 69 & 71, Queen Victoria Street, London, E.C.
Method of Heating by means of Electric Wires imbedded in Cement.

Greenall, John, New Wakefield Street, Manchester.
Improved Steam Washer.

Hoskins, H. **Hope**, 110, Strand, London, W.C.
Jaeger Woollen Underclothing.

Hoskins, H. **Hope**, 110, Strand, London, W.C.
Hygienic Clothing.

Incandescent Gas Light Co., Limited, 14, Palmer Street, Westminster, London, S.W.
Incandescent Gas Light (Welsbach System).

Isaac, B. Richard, 45, South John Street, Liverpool.
Newman's Hose Coupling.

Jennings, George, Lambeth Palace Road, London, S.E.
Century Syphonic Closet, having Ventilating Pipe from space between traps discharging into open air.

Jones, John, 40, Sydney Street, Chelsea, London, S.W.
Condensation Manhole Cover (Double).

Liverpool Electric Supply Co., Limited, 15, Highfield Street, Liverpool.
Switchboard complete with Accumulator and rheostat, to give a pressure of 1 to 2 volts for medical purposes.

Liverpool Lint Co., Mark Street Mills, Liverpool.
Surgical Dressings.

Palatine Engineering Co., 10, Blackstock Street, Liverpool.
Deacon's Waste Meter.

Peace & Norquay, 70, Port Street, Piccadilly, Manchester.
Improved Folding Partition.

Pickup, J. H., & Co., Fountain Street, Bury, Lancashire.
Electric Fan.

Price's Patent Candle Co., Belmont Works, Battersea, London, S.W.
Composite Candles.

Stott, James, & Co., 83, Dale Street, Liverpool.
Mercury Gas Governor.

CERTIFICATES.

Bell, Arthur George, 92, Sherwood Street, Nottingham.
Bell's Fireproof Door.

Billington Bros., Cambridge Street, Liverpool.
Hospital Bedsteads.

Black, William G., 2, George Square, Edinburgh.
Aitken's Apparatus for ascertaining the number of Dust particles present in the atmosphere.

Bowes Scott & Western, Broadway Chambers, Westminster, London, S.W.
Automatic Flushing Grease Trap.

Bradford, Thomas, & Co., Salford, Manchester.
Bradford's Vowel Y Washing and Wringing Machine.

Bradford, Thomas, & Co., Salford, Manchester.
Bradford's "Fishback" Churn.

Bradford, Thomas, & Co., Salford, Manchester.
Bradford's Differential Wringing and Mangling Machine.

Bradford, Thomas, & Co., Salford, Manchester.
New Arch Albany Butter Worker.

British Sanitary Co., 56, Bothwell Street, Glasgow.
Earth Closets.

Carter, Alfred, Limited, 47, Holborn Viaduct, London, E.C.
Carrying Chair and Self-Propelling Chair Combined.

Clark, E., & Co., Queen's Road, Battersea, London, S.W.
Clark's Optimus Coffee Extract.

Cliff, J., & Sons, Wortley, Leeds.
White and Coloured Glazed Bricks.

Cliff, J., & Sons, Wortley, Leeds.
Imperial Porcelain Kitchen and Scullery Sinks.

Cooke Bros., 25, Hardman Street, Liverpool.
Dairy Farmers' Working Dairy.

Dimmock, J., & Co., Albion Works, Hanley.
Perfection Wash Down Closet.

Doulton & Co., Lambeth, London, S.E.
Glazed Fireplaces.

Duckett, J., & Son, Mitre Works, Burnley, Lancashire.
Rest for Setting Drain Traps Level.

Eagle Range and Foundry Co., Catherine Street, Aston Cross, Birmingham.
"Eagle" Grate.

Edmunds, Joseph, Belper Street, Barnsbury, London, N.
Empress Curry Powder.

Gibbs, J., & Son, 27, South John Street, Liverpool.
Improved Ventilating Inlet with large Removable Outside Grating.

Greenwood Bros., 228, Liverpool Road, Manchester.
Automatic Milk Receiver.

Hancock, F. & C., 29, Oxford Street, Dudley.
Mill for Crumbling Bread and Grinding Sugar.

Hancock, F. & C., 29, Oxford Street, Dudley.
Machine for Pressing Butter, Potatoes, and Fruit.

Hutchings, G. J., 47, Featherstone Street, City Road, London, E.C.
Hutchings' Steam Cooker.

Isaac, B. Richard, 45, South John Street, Liverpool.
Allison's Safety Lamp.

Isaac, B. Richard, 45, South John Street, Liverpool.
Maurice's Instantaneous Hose Coupling.

Jennings, George, Lambeth Palace Road, London, S.E.
Porcelain Radial Urinal with Stall and Pan in One Piece.

Jeyes' Sanitary Compounds Co., Limited, 43, Cannon Street, London, E.C.
Jeyes' Fluid Coal Tar Disinfectant.

Jones, John, 40, Sydney Street, Chelsea.
Smoke Machine and Smoke-Bag Stopper for Drain Testing.

Kenworthy, E. N., & Co., Alpha Works, Oldham.
Equipoise Wringer and Mangle.

Kenworthy, E. N., & Co., Alpha Works, Oldham.
Paragon Washer, Wringer and Mangle.

Kenworthy, E. N., & Co., Alpha Works, Oldham.
Handy Curtain Frame.

Killick & Cochran, 51 and 53, Seel Street, Liverpool.
Improved Hydraulic Roasting Jack.

Killick & Cochran, 51, Seel Street, Liverpool.
Ideal Kitchen Range.

Kite, C., & Co., 132, Euston Road, London, N.W.
Lock Valve Ventilator.

Ling, T. (Burroughs, Wellcome & Co.), Snow Hill Buildings, London, E.C.
Tabloids of Compressed Tea.

Lozé, Auguste, 281, West Derby Road, Liverpool.
Aerated Water Machine.

Lyon, John, & Co., 23, Oldham Street, Liverpool.
Mineral Waters.

Magnetite Patent Filter Co., 6, Brown Street, Manchester.
Magnetite Filter.

Newton, Chambers & Co., Thorncliffe, near Sheffield.
Izal Disinfecting Fluid.

Reck, Anders Borch, Gothersgade 155, Copenhagen.
Steam Disinfector.

Renton, Gibbs & Co., St. James' Works, Mill Street, Liverpool.
Hot Water Grate.

Reynolds & Branson, 14, Commercial Street, Leeds.
Sets of Lantern Slides to illustrate Healthy and Unhealthy Houses.

Reynolds & Branson, 14, Commercial Street, Leeds.
Apparatus for Estimating Carbon Dioxide in Air.

Robinson, Thomas, 127, Ramsden Road, Wardle, Lancashire.
"Enable" Method of connecting lead pipe with earthenware pipe.

Sanitation Improvements Co., 26, Canal Street, Wolverhampton.
Day's Stafford Closet.

Shanks & Co., Tubal Works, Barrhead, Glasgow.
Shanks' "Modern" Lavatory with Accessible Quick Waste.

Shanks & Co., Tubal Works, Barrhead, Glasgow.
Instanter Lavatory Basin with Running Water.

Shanks & Co., Tubal Works, Barrhead, Glasgow.
Shanks' Combination Closet, with Cistern immediately behind.

Shaw Bros., 22, Eastbourne Road, Birkenhead.
Cane Drain Cleaning Rods.

Twyford, Thomas W., Cliffe Vale Pottery, Hanley.
Ideal Sink and Supports in Enamelled Fireclay.

Twyford, Thomas W., Cliffe Vale Pottery, Hanley.
Combined "C.V." and Athena Lavatory Basin.

Tylor, J., & Sons, Limited, 2, Newgate Street, London, E.C.
Column Closet and Slop Sink Combined.

Tylor, J., & Sons, Limited, 2, Newgate Street, London, E.C.
Ariston Valve Closet.

Tylor, J., & Sons, Limited, 2, Newgate Street, London, E.C.
Column Waste Preventing Cistern (McCormick's Patent).

Walford, W. Stewart, Dallingboro' Rectory, Wickham Market.
Domestic Turkish Bath.

N.B.—Objects exhibited or invented by any of the Judges themselves are excluded from Awards.

LIST OF EXHIBITS

SELECTED FOR FURTHER PRACTICAL TRIAL.

Acme Ventilating and Heating Co., 35, Tarleton Street, Liverpool.
Upcast Ventilator for Buildings and Ships.

Albion Clay Co., Woodville, Burton-on-Trent.
Paragon Pipes.

Albion Clay Co., Woodville, Burton-on-Trent.
Jones & Sykes' Channel Bends for Manholes and Inspection Chambers.

Arnold, Joseph, 40, Clowance Street, Devonport.
Deodorising Apparatus.

Bowes Scott & Western, Broadway Chambers, Westminster, London, S.W.
Latrine.

Cadbury Bros., Bournville, near Birmingham.
Cocoa.

Coombs' Eureka Aerated Flour Co., Limited, 4, Stamford Street, Nottingham.
Eureka Aerated Flour.

Cooper, A. T., 92, Moray Road, London, N.
Suction and Vacuum Pump.

Cosham, Thomas, Portland House, Newark, Nottingham.
Precipitating Tank and Filtering Beds.

Cullen, James Baines, 104, Wood Street, Liverpool.
Patent Rudder Fastenings.

Doulton & Co., Lambeth, London, S.E.
Improved Apparatus for Heating Bath by Steam.

Doulton & Co., Lambeth, London, S.E.
Isolated Trough Closet.

Duguid, J. L., & Co., 12 and 14, Johnson St., Dale St., Liverpool.
Pulford's Damp-Wall Paint.

Eagle Range and Foundry Co., Catherine Street, Aston Cross, Birmingham.
Safety Bell.

Eiffel Patent Stair Tread Co., Limited, 26, Bath St., Liverpool.
"Eiffel" Stair Tread.

Evans, Sons & Co., 56, Hanover Street, Liverpool.
Montserrat Lime Juice.

Gibbs, John, & Son, 20, South John Street, Liverpool.
Automatic Rainwater Separator.

Gibbs, John, & Son, 27, South John Street, Liverpool.
Inlet and Outlet Ventilators for Ships.

Guibal, Miss Susanna J. F., 7, Great George Square, Liverpool.
Machine for the Preparation of Ribbons required for Typewriters.

Hancock, F. & C., 29, Oxford Street, Dudley.
Steam Oven for Cooking.

Hancock, F. & C., 29, Oxford Street, Dudley.
Cooker and Steamer Combined.

Heinekey, White & Co., 43, Pembroke Place, Liverpool.
Ladas Cream Baking Powder.

International Water and Sewage Purification Co., Limited, 7, Victoria Street, London, S.W.
Process of Sewage Purification.

Iredale Patent Soap Co., Fenwick Chambers, Liverpool.
Ammonia Dry Soap.

Jones, John, 40, Sydney Street, Chelsea, London, S.W.
Ball Valve for Waste Preventers.

Jones, John, 40, Sydney Street, Chelsea, London, S.W.
Double Syphon Waste Preventer.

Jones, John, 40, Sydney Street, Chelsea, London, S.W.
Screw Expanding Drain Stopper and Water Test Indicator.

Kops Brewery, Fulham, London, S.W.
Kops Ale.

Lozé, A., 281, West Derby Road, Liverpool.
Siphon for Aerated Water.

Malabar, Robert, 40, Plumpton Street, Liverpool.
Barrow for Carrying and Socketing Heavy Earthenware Pipes.

Palatine Engineering Co., 10, Blackstock Street, Liverpool.
Lord Kelvin's Hydrant.

Palatine Engineering Co., 10, Blackstock Street, Liverpool.
Lord Kelvin's Fire Valve.

Palatine Engineering Co., 10, Blackstock Street, Liverpool.
Lord Kelvin's Tap.

Parkinson, R., & Sons, Curzon Street, Burnley.
Baking Powder.

Patent Gully Co., Limited, St. Peter's Church Walk, Nottingham.
Iron Gullies.

Quirk, Sharp & Co., 31, Islington, Liverpool.
Washdown Water-closet with large Water Area.

Reid, A. W., & Co., 69, St. Mary Axe, London, E.C.
Expanding Drain Stopper.

Renton, Gibbs & Co., St. James' Works, Mill Street, Liverpool.
Wind Suction Ventilator.

Reynolds & Branson, 14, Commercial Street, Leeds.
Puritzer Aerated Water.

Safety Tread Syndicate, Limited, 15, Barbican, London, E.C.
Mason's Unwearable Non-slipping Stair Treads.

Safety Tread Syndicate, Limited, 15, Barbican, London, E.C.
Electric Light Box Covers.

Safety Tread Syndicate, Limited, 15, Barbican, London, E.C.
Hydrant and Manhole Covers.

Safety Tread Syndicate, Limited, 15, Barbican, London, E.C.
Coal Plates.

Safety Tread Syndicate, Limited, 15, Barbican, London, E.C.
Stirrups and Horse Shoes.

Scott, A. & R., Limited, 28, Buchan Street, Glasgow.
Midlothian Oat Flour and Biscuits.

SEWAGE AND EFFLUENT WATER FILTRATION Co., LIMITED, 35, Waterloo Street, Birmingham.
System of Aeration of Sewage Filter Beds.

SHANKS & Co., Tubal Works, Barr Head, Glasgow.
Shanks' Syphonic Water-closet.

STANDARD SEWAGE AND WATER PURIFICATION Co., LIMITED, Chetham Street, Clayton, Manchester.
" Ozonaic" and Magnetic Iron Cake.

STERLING & SWANN, 61, Lord Street, Liverpool.
Improved Sewer Pipes, with Rest-piece in the Sockets.

SYER, MILTON, 36, Rye Lane, Peckham, London, S.E.
Reliable Drain Plug.

TURNER-CROKER SANITARY APPLIANCE Co.
Gully Traps.

TWYFORD, THOMAS, Cliffe Vale Pottery, Hanley.
Adamant Syphonic Latrine.

TYLOR, J., & SONS, LIMITED, 2, Newgate Street, London, E.C.
Walker's Sand Washer.

WALKER & CARVER, LIMITED, Works, Pendleton, Manchester.
Sanitum Wall Paper.

WALKER, E., & Co., Heckmondwike, Yorkshire.
Iron Pipe, Tin Lined.

WATER CARRIAGE ENGINEERING Co., LIMITED, Mowbray Street, Sheffield.
Merrill's Basin Latrine with Syphonic Discharge.

WHITEHEAD, THOMAS, 103, Great George Street, Liverpool.
Revolving Wind Propelling Exhaust Ventilator.

WHITEHEAD, THOMAS, 103, Great George Street, Liverpool.
Fixed Exhaust Ventilators for Buildings and Ships.

WHITEHEAD, THOMAS, 103, Great George Street, Liverpool.
Maurice's Non-Poisonous Porcelain Paint.

THE EIGHTH INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY, BUDAPEST, 1894.

The Eighth International Congress of Hygiene and Demography was held in Budapest the first week in September, 1894, and its magnitude may be gauged by the fact that the total number of members was said to be larger than that of the previous Congress held in London in 1891, which numbered about three thousand. The titles of about eight hundred papers were set down for reading, nearly double the number read at the previous Congress. These papers were classified in twenty-six sections, of which nineteen were included under the head of Hygiene and seven under that of Demography; at the London Congress there were ten sections, one only being devoted to Demography; and at the preceding Congress held in Vienna in 1887 there were only five sections. In addition to the three official languages—English, French, and German—Magyar was largely used. Hungary rose to the occasion, and Budapest surpassed itself in lavishness of hospitality. Delegates and other members of the Congress were overwhelmed with receptions, repasts, and invitations of all kinds, with visits of interest and excursions, and with sections and papers. The cordiality and hospitality of the Hungarians were unbounded.

In calmly reviewing the impressions left by this last International Congress, there are many points of striking interest. That the cause of public health is advanced by the meeting of experts of all countries cannot be gainsaid. To take a single illustration, how many knew previous to the Congress that Hungary has been the first State to establish a state service of Medical Officers of Schools for the purpose of exercising supervision over the hygiene of schools and scholars, and of giving instruction in hygiene in middle-class schools? How valuable this evidence will be in supporting those who have so long advocated the school teaching of hygiene and the greater supervision of the sanitary condition of schools and scholars. The exchange of ideas, the varying methods of administration and procedure adopted, the different current opinions, and the basis on which they are grounded, all help to widen the scope and to set more firmly the knowledge of sanitarians.

But the value to be obtained is only gained under difficulties—difficulties of language and of organisation. In a large assemblage of persons speaking different tongues the first consideration should be to adopt every means possible to render the proceedings intelligible to the greatest number. With this object the languages in official use should be reduced to the fewest number. Every additional language multiplies the difficulty of procedure, written and verbal. Every paper, or a fair abstract, should be printed beforehand, as many men are capable of reading in a foreign language what they cannot follow when spoken, and few men can speak with lucidity upon a subject, and still less upon the details of a scientific subject, sprung upon them in a strange tongue without a moment's notice for reflection. All papers and abstracts should be obtainable shortly beforehand, either gratuitously or upon a small payment, by any member of the Congress.

As to organization, it is not desirable to have a larger number of sections than necessary, the conjunction of one or more sections temporarily and the subsequent disjunction lead to great confusion, and although the number of sections may be thereby temporarily reduced it leads to delay and rupture of continuity. The Permanent International Committee should draw up a limited programme of sections, and of subject matters to be embraced in each section, for future Congresses it would form an invaluable guide to organisers, contributors, and delegates, and would exclude many extraneous matters that tend to dilute and even swamp more legitimate and pressing subjects. In the question of papers also this programme would assist referees to decide what papers should be accepted or declined. It appears to be most necessary and important that a careful scrutiny and pruning of the papers sent in should be exercised by a competent committee, and it necessarily follows that papers should be submitted *in extenso* or at least in full abstract before being accepted, as the title of a paper is an insufficient description to its contents. This need not apply to authors specially requested to contribute, but it would effectually exclude elementary and advertising papers.

By this means the number of papers might be reduced to a manageable quantity, and the quality might be considerably improved. Even more may be done with advantage to improve the quality and utility of the subject matters to be placed before an International Congress, by extending the system of International Committees, and by instituting also National Committees. The reports of these Committees being printed and circulated beforehand could be taken as read, and might produce fruitful discussions. Furthermore, these Committees, International and National, could bring to the Congress carefully prepared resolutions, with explanatory reports. There is no reason why National Committees should not create themselves and present reports to a Congress. Reports such as mentioned would take precedence of individual papers, and indirectly they would act as a healthy discouragement to the overwhelming flow of diffuse dissertations, and reduce the number and improve the practicability of the resolutions to be submitted to the Congress in plenary sitting. There is also a growing tendency in all Congresses to make visits and excursions during the sitting of the sections; this is a practice that is fatal to good work, and a question for serious consideration in the future. It is obviously necessary to prevent this overlapping if the sittings are to be well attended, and the deliberations are to lead to good results.

It would also be a desirable thing for a National Committee to arrange that certain of its members attending an International Congress might be told off to each section in such a manner that they would be able to make sectional reports of the most valuable parts of the proceedings, and so assist each other and their nation by co-operative organisation to gain a more complete and satisfactory knowledge of what takes place, instead of wandering hopelessly, like sheep without a shepherd, into many places in search of information. The writer would plead strongly for the timely organisation of a National Committee, prepared to be thoroughly representative, and capable of presenting to the sanitary world a compiled report of all that is valuable at an early date after a Congress, and of combining beforehand for the purpose of discussing and carrying needful resolutions.

To pass to a more detailed review of the Congress,—on the evening of Saturday, 1st September, the members of the Congress were welcomed at an introductory meeting in the National Museum, where the Minister of the Interior, Karl v. Hieronymi, President of the Congress, accompanied by the Rector of the University, Professor Fodor, and by Professor Coleman Müller, the General Secretary, was the centre of attraction.

On Sunday, 2nd September, in the large Hall of the Municipal Redoute the Congress was solemnly declared opened by His Imperial and Royal Highness, Archduke Karl Ludwig. The Hall was thronged with representatives in official, military, and evening dress, and a considerable number of ladies were present. Congratulatory and complimentary speeches were made by a large number of delegates of various nationalities and in many languages. These could be heard only a short distance from the platform. To the majority of the assembly the ceremony was an imposing spectacle. At the conclusion of this ceremony the Exhibition on the upper floor of the Polytechnikum was formally opened by the Minister of the Interior. In the afternoon, at the Academy of Science, a solemn oration was delivered by Professor Hueppe, of Prag, in memory of Semmelweis, and those assembled subsequently drove to the cemetery, where Professor Kezmarszky unveiled the public memorial to Semmelweis, upon which Dr. Duka deposited an international wreath. In the evening the delegates were received at the Court of His Royal and Imperial Highness Archduke Karl Ludwig in the Königsburg Palace at Buda.

On Monday the Sections commenced work and continued their sittings throughout the week. Sections 9 and 10, public buildings and dwellings, speedily amalgamated; Section 15, sport, found little to do; and Sections 18 and 19, pharmacology and nursing, were concerned more with the cure than the prevention of disease. Many papers appear not to have been presented or to have been crowded out. Some of the Sections concluded their labours by Wednesday, and some of the demographical Sections sat at irregular intervals.

The greatest interest centred in Section 1, bacteriology, where, on the first day, immunity was discussed; on the second day, diphtheria, in conjunction with Sections 2 and 5 (prophylaxis of epidemics and hygiene of children); and on the third day cholera, in conjunction with Sections 2 and 3, (prophylaxis and tropical hygiene).

Professor Hans Buchner, of Munich, read a paper upon "Immunity," in which he contended that natural resistance against infection, so-called natural immunity, depends upon other conditions and causes than artificial or acquired immunity. Natural resistance depends, on the one hand, upon the bactericidal action of certain liberated products of the organism, so-called alexines; on the other, upon the congenital indifference of the tissues and cells of the body to individual bacterial poisons. As a rule natural resistance cannot be transmitted to other organisms by the blood. Lencocytes perform an important function as natural protectors of the organism, not as phagocytes, but by means of the substances they secrete, phagocytosis being only a secondary phenomenon. Artificially begotten or acquired immunity depends upon the presence of modified, poisonous, specific bacterial products, so-called antitoxines, either in the blood or in the tissues of the organism, or in both. As a rule antitoxines and the artificial immunity they produce may be transmitted by the blood and the milk. The action of antitoxines is not based upon the direct destruction of specific bacteria by contact with them, but takes place within the organism, and only by modification of the organism by a diminution of the specific susceptibility of the vital parts of the organism, so that they are rendered insusceptible and resisting.

Professor Victor Vaughan, of Michigan, detailed some experiments, showing that sub-cutaneous injections of nucleinie acid render rabbits and guinea-pigs immune to subsequent inoculations of virulent cultures of the diplococcus of pneumonia.

Professor L. V. Udrausky of Kolozsvar entered into the question whether it is possible to classify the bacterial products known up to the present time in groups according to chemical composition. Besides the alkaloidal and the albuminous bacterial poisons there are the bacteriotoxines, belonging to neither of these classes. It appeared to him that the best guide to the position of bacterial poisons in pathology is to be found in the varying intoxications by bacterial products reproducing the signs and symptoms of corresponding infectious diseases.

Professor Joseph de Fodor, of Budapest, discoursed upon the effects of increased alkalinity of the blood rendering it more microbicidal in action and the animal more resistant to the virus of anthrax. He detailed his experiments with the virus of anthrax, and also others with those of cholera, typhoid, tuberculosis, and swine erysipelas.

Dr. Metchnikoff, of Paris, maintained his well-known conclusions, that immunity was due to the activity of living cells, that leucocytes exercised a chemiotactic power, but that phagocytes played the chief part in taking up and destroying the micro-organisms.

Professor Denys, of Louvain, recorded his experiments on rabbits, which showed that the bactericidal power of serum was not derived from blood but from the leucocytes.

On the second day the reports of the various National Committees upon diphtheria were presented in accordance with resolutions passed at the previous Congress, Herr Hieronymi, Minister of the Interior, presided. Professor Löffler first presented the German report, the main points of which were:—That as the bacillus of diphtheria might remain for weeks and months in the throat of an infected person even after convalescence, a systematic and continuous examination of the throat should be invariably carried out in all cases; that compulsory notification, isolation, and disinfection should be enforced; that in addition to cleanliness, dryness, access of light and air, and local treatment, isolation should be enforced until the disappearance of the bacillus. Dr. J. S. Billings presented the American report, and stated that a system of bacteriological examination was in force in some cities in the United States. He also stated that the death-rate from diphtheria was falling in the States, but far more in the urban than the rural districts, due to the effects of isolation and disinfection. The report of the British Committee was read by Dr. Edward Seaton, and he pointed out that the tendency had been for the disease to concentrate itself in towns and towards the south-eastern portion of England. The influx of population into towns and the aggregation of children in schools influenced the trend of the disease. He also complained that hygiene in England was of too narrow a scope and did not sufficiently embrace sanitary or preventive medicine, and pleaded for the systematic encouragement of scientific observation and the furtherance of medical preventive work. Other national reports were taken as read. The report of the French Committee, in addition to recommending compulsory notification, isolation, and disinfection, urged the daily examination of the throats of children, and also that medical men should invariably have recourse to bacteriological examination for early diagnosis, and to the injection of anti-diphtheritic serum for treatment.

At the close of the reports, Professor Roux made one of the most important communications to the Congress. He detailed the results of the treatment of children at the Hopital des Enfants Malades in Paris with antitoxine serum derived from the horse, and compared these results with the previous records of the hospital and of another children's hospital where such treatment was not in use. Briefly, one-fourth of the children were found not to be suffering from true diphtheria, in those affected the mortality was reduced from 50 to 26 per cent. He differentiated those suffering from diphtheria associated with other organisms from those suffering from pure diphtheria, and after eliminating those dying from collateral causes he concluded that the true mortality of the cases of pure diphtheria properly subjected to the treatment was only 1·7 per cent. A marvellous result full of promise if borne out by further experience, and as the serum produces no toxic effects, this discovery of Professor Behring will doubtless before long be tested all over the civilised world. Dr. Aronson, of Berlin, also communicated the favourable results obtained by him in the treatment of the disease by antitoxine.

Mr. Adams, F.R.C.S., contributed a paper on the movements of the subsoil water in relation to the occurrence of diphtheria in Maidstone, valuable observations already well known in this country.

On the third day cholera was the subject under consideration. Professor Gruber, of Vienna, considered that neither artificial cultures nor researches upon animals established the diagnosis of cholera as Koch's school asserted; something more was wanted. Dr. Metchnikoff held that the cholera vibrio alone was not the cause of cholera. Many had swallowed them without being attacked by cholera. In the intestines there are many micro-organisms which favour the development of the cholera bacillus or the reverse. In those who possess the former cholera develops; those who possess the latter remain immune. Acting upon this assumption, he had succeeded in developing cholera in animals hitherto considered immune. Professor Pertik, of Budapest, had found cholera bacilli in 60 per cent. of fatal cases, but he had also obtained pure cultures from perfectly healthy soldiers. He illustrated by photographs the variations in cholera vibrios. He attributed the late epidemic in Budapest to polluted water. In the discussion there was a consensus of opinion that the cholera bacillus was insufficient to alone account for the peculiar incidence of the disease.

Professor Kuborn, of Seraing-Liege, read a paper upon the origin, character, and route of the cholera epidemic in Belgium in 1892-94, and the measures organised for defence. In July, 1892, workmen returning from Paris introduced the disease into Eastern Flanders and into Hainant (Jumet), and in August ships from Havre and from Hamburg introduced the disease into Antwerp. Thence it spread throughout Belgium, causing over 2700 cases of sickness and nearly 1500 deaths. The disease travelled by the routes of the canals and rivers, communicability by individuals and by infected objects was frequently recorded. Insanitary quarters and houses and their occupants were specially attacked, and the disease returned to the same localities and houses as in previous years. The smaller number of cases and of deaths, compared to former epidemics, was attributed to improved sanitary supervision following upon the compulsory notification of suspected cases, and the substitution of public water supplies for old wells and tanks.

Dr. Stekoulis, of Constantinople, expressed the opinion that quarantine is not always reliable, that the best prophylactic measures are the sanitation of towns, isolation of the sick, and rigorous disinfection. Enlightened opinion is evidently travelling eastward towards the sources of cholera.

Surgeon-General Gordon gave his experiences of cholera in India. In the discussion upon cholera many took part.

The subject of Oriental plague was brought before these Sections by Prof. Roux.

Dr. Cooper Pattin, of Norwich, presented a paper upon the tuberculosis in England and Wales. He advocated the compulsory notification of the tuberculoses, and held that public opinion cannot be suffered to become the determining factor, but must be content to follow in the wake of expert advisers. He would require the presence of the tubercle bacillus to be demonstrated in order to make the notification valid. Small-pox, scarlet and enteric fevers, cholera, and diphtheria do not together cost the country so much in health and money as the tuberculoses; but the former are of high intensity and short duration and strike terror, whereas the latter are of low intensity and long duration, and are suffered to cause nearly one-half of all deaths between the ages of fifteen and thirty-five. Notification would enable printed instructions to be sent to the victims of the disease as to preventive treatment, nursing, and disinfection, and inimical sanitary defects to be remedied, and also enable the indiscriminate admixture of tuberculous and healthy children in schools, and adults in factories and workshops, to be prevented. He would look forward to the provision of special hospitals for poor cases, and to the regular inspection of all cattle by veterinary inspectors.

To the tropical Section, Sir Joseph Fayrer, K.C.S.I., also presented a sketch of the physical and climatic conditions of India, and their relation to health and disease. He stated that in India every effort is made to promulgate and enforce sanitary regulations. An important result of the observations of the many able medical officers of the sanitary department has been to show that epidemics are to be controlled by sanitary work, and that cholera is to be prevented or modified in this way alone, whilst all quarantine and coercive measures are futile and hurtful. By basing action on experience and facts verified by skilled observation, and not on hypothetical explanation, steady progress is being surely made.

Mr. Acworth, of the Metropolitan Asylums Board, in the second Section, described the provision made by the Board in London for small-pox, and the methods adopted for dealing with outbreaks.

In Section II., also enteric fever was discussed. Professor Drasche, of Vienna, laid stress upon the communicability of typhoid by drinking water, and quoted the statistics of many towns to show that a decrease in the mortality from the disease followed upon the introduction of an improved water supply. Several other papers upon the same subject were read.

Dr. Duka, of London, presided in Section III., where Dr. Alcide Treille, of Algiers, spoke of the Ramadan and diseases attacking Mussulmen, that the commands of the Koran did not hold in check. Dr. Armauer Hansen treated of leprosy. The regulations against leprosy were fundamentally humane, in that they made free state provision for its victims. Entry into the special hospitals was voluntary, but nevertheless many availed themselves of them, so that by segregation the cases of leprosy had been reduced in Norway from 1883 in 1856 to 900 in 1890. Dr. Beavan Rake, of the Trinidad Leper Hospital, observed increased sexual passion in lepers, and considered it requisite to prevent marriage between leprous and non-leprous persons by allowing leprous persons to intermarry, especially as the Leprosy Commission found that 60 to 70 per cent. of leprous pairs were sterile, and less than one child was on the average born to fertile couples. This form of intermarriage he urged would conduce to the segregation of lepers and leper colonies.

Dr. George Thin, of London, compared the various colonial regulations with regard to lepers, differed from the conclusions of the Leprosy Commission, and regretted the effect they would have upon the progress of the provision for lepers. Dr. Finlay, of Havana, called attention to the communication of Yellow Fever by mosquito bites, and he attributed the immunity of natives and old residents against the disease to repeated slight infections producing mild attacks. Dr. G. V. Poore also brought before the meeting some observations from Hong Kong upon the recent epidemic of plague.

The second and third Sections held a conjoint sitting, in which Professor

Laveran introduced Malaria. He dwelt upon the fact that in various parts of the world the plasmodia had been demonstrated in the blood of patients suffering from Malaria. His later had confirmed and amplified his earlier observations, although he had not succeeded in cultivating the plasmodia artificially or in discovering them in swamp waters, but the presence of the plasmodia in the blood was diagnostic of the disease. Dr. Duka, who was in the chair, exhibited photographs of preparations on behalf of Surgeon-Major Ronald. The discussion called forth conflicting opinions from those present.

The hours of labour formed a prominent subject of discussion in the Section devoted to the hygiene of trades and agriculture (IV.). Various speakers advocated daily hours of labour varying from eight to ten, and disserted upon the effects of increased and diminished number of hours upon the health and wellbeing of populations. The diseases and accidents of industrial workers also formed a topic of discussion, to which many contributed. Especial notice was paid to diseases caused by dust by Dr. Jehle, of Vienna, and others, and to lead-poisoning by Dr. Lewy, of Vienna. Dr. Jelineau, of Paris, confined his notes to the influence of tobacco dust upon the health of workers in tobacco factories, and traced epileptic cases to this cause. Dr. Julius Donath, of Budapest, gave an account of his observations upon mercurial poisoning amongst the workers in factories of Edison's incandescent lamps, the source being the mercury used in the air-pumps, and he related how the disease had been minimised by the substitution of patent mechanical for mercurial pumps. It was protested that such an invention should not be kept secret but thrown open to the world.

In the Section relating to children (V.) Dr. Francis Warner read the Report of the Committee investigating the physical and mental condition of children in schools, of which Committee Sir Douglas Galton is Chairman, and compared the results of the examination of 100,000 children.

Dr. Albert v. Berzeviczy opened the Section on the Hygiene of Schools (VI.) with a discourse upon the value of physical education, in which he cited the example of England in exercises and athletic games, as conducive to the development conjointly of body and character, and pleaded for the harmony of physical address and intellectual skill.

A great number of papers were presented to this Section upon exercises, construction and fitting of school buildings, sanitary arrangements, lighting, nervousness, epidemics, and other points, which would occupy undue space to quote in detail; but great stress was very generally laid upon the necessity for teaching in schools, and putting into practice, the elements of hygiene—personal, domestic, and public.

It was a notable fact that the Sections dealing with State Hygiene (XIV.), the Hygiene of Towns (VIII.), of Public Buildings (IX.), and of Dwellings (X.), were sparsely attended. In Section VIII. the results in the sewerage of towns during the last ten years formed the subject of several papers. M. Bechmann, City Engineer of Paris, held that the system of draining away waste and polluted liquids by sewers was preferable to all others. The separate system and other systems have made no progress, and are only of limited application under special circumstances. For drains small automatically cleansing pipes are preferable to the narrow-arched conduits formerly allowed. The purification of sewage becomes daily more important, and irrigation maintains its incontestable superiority. Sewers rates might in some towns serve to create a fund for sanitary improvements. M. Franz Berger, City Architect of Vienna, described the development of the sewerage system of Vienna by the building in and covering of brooks and ditches, the laying of stoneware pipes and of sewers, and conducting the sewerage into mains. The ground water level was permanently levelled by draining. The sewerage was discharged below Vienna into the Danube in such a manner as to provide that when the time arrives it may be irrigated on to land at present used for other purposes. Statistics show a marked improvement in the health of the City coincident with the progress of sewerage. Other papers upon the same subject were read.

Dr. Francis Stevens (London) presented a paper tending to show that a sewer-man's life was a healthy occupation conducive to longevity. Dr. Olah (Budapest) discoursed upon the subject of pavement materials from a hygienic point of view, condemning wood, and placing asphalt first, followed by asphalt macadam and keramite. The last is made from pure clay dried, pulverised, pressed into blocks under heavy pressure, and heated up to 1400° C. during ten days and allowed to cool. It is claimed to be more durable than trachyte or even granite.

The Sections upon public buildings and dwellings sat continuously together, and temporarily that relating to towns was also conjoined. A number of papers relating to the provision of dwellings for the working classes and to the hygiene of dwelling houses were read. Dr. Weyl, of Berlin, read a paper upon a new form of fire-closet for the destruction of house refuse, but especially of fœcal matter, and set forth its value in towns especially during epidemic periods. Central heating of houses was also discussed, Sir Douglas Galton contributing a paper upon the subject. M. Siemens, of Dresden, described an apparatus for heating interiors by gas by means of a new form of regenerative burner.

Professor Corfield (London), seconded by Dr. Pistor (Berlin), moved (1) That the general health of the population is improved and the spread of diseases prevented in towns and dwellings by the frequent removal of all foul matters, and by copious supplies of pure water. (2) That the paving of streets should be smooth, and as far as practicable impervious, to facilitate cleansing and also to prevent contamination of the subsoil. (3) That the access of ground air and moisture to houses should be prevented wherever necessary by means of an impervious basement floor and a damp-proof course in the walls. (4) That house drains should be water-tight, and should each be provided with a disconnecting trap to prevent access of foul air from the sewer, and be freely ventilated. (5) That street sewers should be ventilated in such a manner as to prevent foul air entering the streets and houses, and should be well flushed so as to prevent the accumulation of foul deposits in them. (6) That houses should not be higher than the streets in which they are, nor built back-to-back. (7) That regulations should be made by public authorities with the view of enforcing the practical application of the principles here laid down. These propositions gave rise to severe discussion, the two points most objected to being the provision of disconnecting traps to house drains and the condemnation of back-to-back houses, especially the latter. M. Bechmann, the Chief Engineer of Paris, took strong objection to the condemnation of back-to-back houses, on the plea that the principle entered into the construction of most Continental houses round a central court-yard, and that to carry out such a resolution would mean the demolition of three-fourths of the City of Paris. Several speakers failed to see that the case of Paris justified the negation of a principle sound in itself and beneficial to public health. Ultimately it was agreed to appoint a committee to consider and report upon the propositions.

Mr. Aldwinckle, of London, described the latest form of fever hospitals erected by the Metropolitan Board, and Mr. Fellner, of Vienna, the latest type of theatre construction, providing the maximum safety against fire, easiness of exit, and access of light and air.

Mr. Blashill, Architect of the London County Council, described the dwellings in blocks in course of erection by the Council. He alluded to the clearance of insanitary areas, the conditions to be dealt with, and the difficulties to be overcome, especially in reference to the Boundary Street area. He described the latest development in the form of construction of blocks of dwellings, and divided them into two classes, self-contained and associated dwellings. In the former he included dwellings each of which contained within itself or attached to it all that was necessary for family life; in the latter he included dwellings for which sculleries, sinks, wash-houses, or laundries, and water-closets were provided separate from or unattached to the dwellings and for the common use of the occupants. This class of dwellings is cheaper than the former. The dwellings contain from one to four rooms, according to the estimated requirements of persons or families varying in number. All habitable rooms must be at least 8ft. 6in. high, living rooms must contain an area of at least 144 square feet, and bedrooms at least 96 square feet. To self-contained dwellings a scullery with sink and copper and a water-closet must be attached, but most important of all, the water-closet must be approached from an open lobby so as to be entirely cut off from the house.

Female physicians engaged the attention of Section XIV. (State Hygiene) and monopolised too much time. Of greater interest were the various papers descriptive of the system of public health services in vogue in various States, more particularly in the smaller States of Eastern Europe. Still more interesting were the descriptions of various methods suggested for ridding cities of refuse.

Richard Schneider, engineer of Munich, fully described the system by which all refuse can be effectually destroyed and converted into materials for construction, by means of refuse destructors. He described his own design and entered into full details of construction and cost. The burning of organic matter and the cremation of bodies were in general favour.

Dr. Felix, of Brussels, described a coffin composed of an artificial mineral that is absorbent and disinfectant, and destructible and indestructible as desired. This system of proposed burial he has denominated "tachyphage." A general resolution was proposed that the best method of disposal of all refuse is by burning. To this sweeping resolution Dr. Vivian Poore took exception, as unscientific, wasteful, inapplicable in rural districts, undesirable in small towns, and only to be resorted to as a matter of extreme necessity in large cities. He also affirmed that no epidemic had ever been traced to a cemetery, and considered proper and scientific burial the safest, cheapest, and quickest method of disposing of the dead.

A display of crematory apparatus was to be found in the Exhibition held in connection with the Congress, and in a special catalogue much valuable information in reference to cremation in various countries was compiled.

In the Samaritan Section (XIX), a paper by H.R.H. Princess Christian was read describing the progress of the organisation of nursing in Great Britain, and advocating that the State should recognise diplomas of nursing, and a register for qualified nurses. Professor Singer, of Vienna, brought forward the question of the eight hours' day of labour. He pointed out the evils of overwork, and that it was a modern retrogression cotemporary with the introduction of steam power. In America and England the eight hours' day has been introduced into Government factories, and private workshops are following a similar course in some instances. In Australia it has been recognised since 1856, and without any ill results; on the contrary, crime and alcoholism have proportionately diminished. He laid stress on the degeneracy of children produced by long hours of work on the mothers, and the fact that modern appliances rendered it unnecessary to work more than eight hours. With a view to the improvement of the health and intelligence of nations he moved a resolution accepting the principle of the eight hours' day, which was supported by several prominent representatives of commerce.

The Ministerial Secretary Kanocz, of Budapest, pleaded for the passing of a Hungarian Poor Law providing poor law inspectors, prescribing who should be entitled to assistance, and under what conditions.

In the Demography Sections many interesting papers, too numerous to mention, were read. Amongst others, one by Dr. Arthur Newsholme upon the "Mortality in Block Dwellings of the Industrial Classes." He showed that in these buildings statistics did not bear out the dictum of Farr, that increased density of population on a given area necessarily produced increased mortality, but that scarlet fever, measles, whooping cough, and diphtheria, tended to spread and caused a higher mortality in these buildings than in the surrounding districts.

At the plenary meeting of the Congress so few members were present, so many resolutions submitted, and to these there was such opposition as to considerably discount the value attaching to the results of the meeting.

Any detailed account of invitations and excursions would run to inordinate length, but the entertainment by Count Esterhazy at Totis of some 250 members was of a princely scope, and the reception was most cordial.

In spite of the many difficulties with which our Hungarian hosts were confronted, the Sanitary world is indebted to them for a superabundant provision for the mind and for a profuse hospitality. J. F. J. S.

NOTES ON LEGISLATION AND LAW CASES.

Prepared by Mr. A. Wynter Blyth.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Before Mr. Justice North.

THE WEST SURREY WATERWORKS COMPANY *v.* CHERTSEY UNION.

Section 52 P. H., 1875, is not to be construed to the effect that a Sanitary Authority interferes with the rights of an existing water Company by taking water from other sources than the water of the Company for the purpose of flushing sewers.

This was an action by a Water Company to restrain a Rural Sanitary Authority from supplying themselves with water for the purpose of flushing their sewers in infringement of the plaintiff's monoply, on the ground that the defendant authority were exceeding their powers as restricted by the Public Health Act, 1875. Sec. 51 of the Public Health Act enables a Sanitary Authority to provide a water supply proper and sufficient for public and private purposes. Sec. 52 makes it unlawful for the Sanitary Authority, where there is a Water Company having power to supply the district for which waterworks are proposed to be constructed by the Authority, to construct such waterworks if the Water Company is able and willing to supply water proper and sufficient for all reasonable purposes for which it is required by the Local Authority. The defendant Board have recently constructed an entirely new system of sewerage for Weybridge and Oatlands Park. The sewerage by this system is to be taken along sewers, from which all surface water is excluded, to a point near the Thames, there to be pumped to a piece of land some way back, where the sewage is to be dealt with. Sixteen automatic flushing tanks, with a total capacity of 28,750 gallons, have been provided for the purpose of keeping the sewers clean, and, under arrangements with the Thames Conservators, provision has been made for taking water from the Thames near the pumping station both to supply the flushing tanks and for condensing purposes. The action was brought on a statement of facts to have a decision on the point of law, whether what the defendant Authority had made provision for was prohibited by Section 52 of the Public Health Act, 1875.

Mr. Cozens-Hardy, Q.C., and Mr. Mulligan appeared for the plaintiff Company; Mr. Swinfen Eady, Q.C., and Mr. F. Gore Browne for the defendant Authority.

Mr. JUSTICE NORTH, in the course of his judgment, pointed out that the construction of the Public Health Act contended for by the plaintiffs led to the absurd conclusion that the defendants would be bound to use nothing but pure and wholesome water fit for drinking for this purpose of flushing their drains, though they could get water fit for their purpose at a much less cost. He examined the Sections of the Public Health Act relating to the supply of water by a Public Authority in connexion with the interpretation clause, and came to the conclusion that the prohibition on an Authority from constructing waterworks, in competition with a Water Company able and willing to supply water proper and sufficient for all reasonable purposes, was limited to works supplying the public generally, and that there was nothing in the Public Health Act to prevent the Authority from supplying themselves for such a purpose as flushing their sewers or condensing steam in their own engines. As the only question between the parties was the point of law on the construction of the Public Health Act, judgment was given for the defendants.

COURT OF APPEAL.

Before Lords Justices Lindley and Lopes.

YORKSHIRE (WEST RIDING) COUNTY COUNCIL *v.* HOLMFIRTH URBAN SANITARY AUTHORITY.

Appeal from the Queen's Bench Division (71 *L. T.* Rep., n. s. 217).

Rivers Pollution Prevention Act, 1876 (39 & 40 Vict. c. 75). Sections 3, 10, 20.

It is no sufficient answer to a complaint of pollution by sewage of a stream under Section 3, that the sewage is carried by old channels used at the date of the passing of the Act and that nothing has been done to aggravate the nuisance ; it must be shown that the best practical means are being taken to render the sewage harmless.

In 1884 the Holmfirth Local Board was formed and took over an system of drainage, carrying sewage into a mill tail from whence it flowed into the river Holme.

The West Riding County Council took proceedings against the Local Board in the County Court, under Section 3 and Section 10, to restrain them from knowingly permitting sewage to flow into the river Holme.

The County Court Judge held that there was no evidence of any offence bringing them within the meaning of the Act.

The plaintiffs appealed, and the Divisional Court held that there was evidence on which the Judge ought to have held that the defendants were knowingly permitting the sewage to fall into the river, under Section 3, and that he ought to have called on them to prove, if they could, that they were adopting the best method of rendering the sewage harmless.

From this decision the defendants appealed.

Lord Justice Lindley: After citing the facts of the case the learned judge read Section 3, " Every person who causes to fall or flow, or to be carried into any stream any solid or liquid sewage matter shall (subject as in this Act mentioned) be deemed to have committed an offence against this Act." The first question which arises is whether the nominative "every person" applies to such a body as the Holmfirth Urban Sanitary Authority. That question must be answered in the affirmative, because Section 20 says "person" includes anybody of persons, whether " corporate or unincorporate." " Person," therefore, in Section 3 is not confined to an ordinary individual but extends to and includes an Urban Sanitary Authority. The next question is whether that person causes to fall or flow or knowingly permits to fall or flow or to be carried into any stream any sewage matter. The facts of this case are apparently these: Before the Urban Sanitary Authority became in a position to control the sewers, before the sewers were vested in them, there were in existence old sewers which were used by the inhabitants of Holmfirth, and what the defendants have done as I understand it is this, they have repaired the old drains by putting in some new pipes, I suppose the ordinary glazed sewer pipes, and they have straightened the sewers so as to shift the outfall which used to be in the old mill tail into the river. The substitution of pipes has not been a small matter, because they have substituted we are told some 5000 yards, which is about three miles. What the effect of that may be I do not know. Whether the old sewers were so out of condition that a good deal of leakage took place so that the sewage which flowed into the river was less than it is now, now that these new glazed pipes have been put in I do not know, but the learned judge of the County Court finds as a fact, and I accept his finding, that there has been no material increase of sewage, that the straightening of the sewers and the substitution of glazed pipes for the rubble drain have not appreciably increased the mischief. Under these circumstances I do not know that the defendants have caused the sewage to flow into the river, but have they knowingly permitted it? *primâ facie* I take it that the owner of a sewer which discharges itself into a river does knowingly permit that discharge. If the person who is the owner of the sewer could show that he does not knowingly permit it, because he cannot prevent it, it would be competent for him to do so, but there is no evidence of that sort here. It may be and probably is true that individuals have a right to pour their sewage into this sewer. It does not follow from that, that the Local Board have no power to prevent that sewage matter from falling into the river undeodorised and undealt with. At all events no evidence has been adduced before the learned County Court Judge by the defendants to show that what is done is that which by law they cannot prevent. Well, under these circumstances it appears to me a *primâ facie* case has been made out against them, that they do in the terms of this Act of Parliament "knowingly" permit this sewage matter from their own sewers to fall into this river. That being so, what is the duty of the learned County Court Judge? his duty is to consider under Section 10 what ought to be done. But he has not done that, he has stopped short. He has construed this Act of Parliament in favour of the defendants and has in substance held that he has nothing to do with the case, except to dismiss the plaint because the defendants have done nothing. In my judgment he has misconstrued Section 3, he has held that the defendants have not committed any breach of Section 3, because they have simply allowed matters to go as they were, and has treated as immaterial the substitution of the glazed pipes for the rubble and the straightening of the sewer; there I think he is wrong, because, he has disregarded the latter part of Section 3.

LORD JUSTICE LOPES concurred, and in the course of his judgment said, I presume that if they could prove that they could not prevent this sewage falling into the stream, that at any rate would be an answer to the plaintiff, because I find Lord Justice Bowen says in

Kirkheaton District Local Board v. *Ainley*, *1892*, *2 Q. B.*, *284*, it might possibly be an answer to the complaint, that they have neglected their duty to deal with the sewage in their sewers if they could show that they were actually without the means of disposing of it and had not the power in any reasonable way to dispose it, but I shall wait until the Local Board can satisfy me that it is in such an unfortunate position before I decide that question. In this case there does not appear to me to be anything to show that the plaintiffs are in that position. On the contrary, from materials before me I cannot but think that there are means by which they can deal with the sewage in those sewers so as to prevent it finding its way into the stream, if they have the power they are bound to do so, therefore I think that they themselves are within the section as persons who permit the sewage to flow into the stream. It appears to me that those expressions of the learned Lord Justice are applicable to this case, one is unwilling to express any decided opinion with regard to any matter which might arise on the evidence before the County Court Judge but it does suggest itself to one's mind whether by cesspools or by filtration, or something else, the fall into the river might not be prevented. I entirely concur with my brother Lindley in thinking that the learned County Court Judge has acted prematurely in this matter and that the case ought to go back to him in order that he may hear the evidence and then determine what in his opinion ought to be done under Section 10 of this Act.

Appeal dismissed with costs.

MEETING HELD.

The Congress and Exhibition were held at Liverpool commencing September 24. The arrangement of the meeting was fully detailed in the Programme given in Part II. of The Journal, and further notes of the meeting are given in the Report of the closing meeting on page 462. A number of excursions were arranged to places of interest in and around Liverpool, and on Saturday a large party visited Chester and Eaton Hall; and another party visited Ormskirk and were personally received by the Earl of Lathom.

FORTHCOMING MEETINGS OF THE INSTITUTE.

SECOND COURSE OF PUBLIC LECTURES ON THE SANITATION OF INDUSTRIES AND OCCUPATIONS.

The Council of The Sanitary Institute have arranged for a second course of free public lectures on the Sanitation of Industries and Occupations, to be delivered by well-known authorities; as they think that further knowledge on this important subject will be of utility to those who have charge of the Public Health in factory districts. This is becoming more than ever necessary, as the Sanitary Inspectors of Local Authorities have recently had cast upon them a large increase of work hitherto performed by Factory Inspectors, which has already led to special Inspectors being detailed off for these duties in a number of districts.

Many will, therefore, probably wish to qualify themselves with a knowledge of the Sanitation of Factories, Workshops and Work-places, with a view of obtaining Factory Inspectorships or Inspectorships under Local Authorities in factory districts.

It is hoped also that most employers and managers will desire to learn the practical application of sanitary principles to particular industries.

The subjects embraced in this second course of Lectures will be as follows:—

Nov. 1. "Coal Mining" (Illustrated by Lantern Views). Simeon Snell, F.R.C.S.EDIN., M.R.C.S.ENG., Ophthalmic Surgeon to the General Infirmary, Sheffield.

„ 8. "Quarrying of various kinds: Granite, Marble, Stone, Slate, Chalk, and Limestone." C. Le Neve Foster, D.SC., B.A., F.R.S., H.M. Inspector of Mines, Professor of Mining, Royal College of Science; Llandudno.

„ 15. "Workers in Mercury, Phosphorus and Sulphur." T. Eustace Hill, M.B., B.SC., F.I.C., Medical Officer to the County Council, Durham.

„ 22. "Chlorine and Chrome Compounds." D. J. O'Neil, M.B., Certifying Factory Surgeon; Farnworth.

„ 29. "Workers in Copper, Zinc, Brass, and Tin." R. M. Simon, B.A., M.D., Physician to General Hospital, Birmingham.

The Lectures will be delivered in the Parkes Museum, Margaret Street, W., at 8 p.m.

THE EIGHTEENTH LONDON COURSE OF LECTURES AND DEMONSTRATIONS FOR SANITARY OFFICERS.

These Lectures have been arranged by The Sanitary Institute for the special instruction of those desirous of obtaining knowledge of the duties of Sanitary Officers.

The various subjects will be dealt with in a course of Twenty-one Lectures, given by well-known authorities, and will be illustrated with Diagrams, Drawings, Models and Lantern Slides. The Lectures will comprise the subjects scheduled for the Examinations of the Institute.

The course will have a further use in supplying the wants of acting Inspectors and of other persons desirous of obtaining a practical knowledge of Sanitary requirements and regulations. At the close of each Lecture students will be allowed to ask questions upon the subjects treated. The Lectures will be given on Mondays, Wednesdays, and Fridays at 8 p.m. in the Parkes Museum, Margaret St., W.

Visits to Trade Premises, Refuse and Sewage Disposal Works, Disinfecting Stations, and other Public and Private Works, illustrative of Sanitary practice and administration, have been arranged in connection with these Lectures. A pamphlet giving particulars of these visits will be supplied to each student on taking his ticket for the course.

The fee for the course is £1 5s. Those students who do not desire to attend the first five Lectures on Elementary Science can attend the remainder of the course for the fee of £1 1s.

Surveyors and Inspectors holding office will be admitted at Half fees.

Students who enter their names for one of the Examinations of the Institute, at the time of taking their ticket for the Lectures, can have Half-a-Guinea carried towards their fee for Examination.

Members and Associates of the Institute are admitted to the Lectures without payment, but cannot introduce friends.

The Museum of Sanitary Appliances and the Library will be open Free during October and November to students attending the course.

Special arrangements have been made by which students can obtain the loan of books at a small fee.

Oct. 17.	"Elementary Physics." (Lecture I.) JOHN CASTELL-EVANS, F.I.C., Lecturer on Inorganic Chemistry and Chemical Physics at the City and Guilds of London Technical College, Finsbury.
" 19.	"Elementary Physics." (Lecture II.) JOHN CASTELL-EVANS, F.I.C., Lecturer on Inorganic Chemistry and Chemical Physics at the City and Guilds of London Technical College, Finsbury.
" 20.	"Practical Demonstration of Examples of Building Construction under the Bye-Laws and Offensive Trades, &c., at Mitcham." Conducted by Dr. L. W. DARRA MAIR, Medical Officer of Health, Croydon Rural Sanitary Authority.
" 22.	"Elementary Chemistry." (Lecture I.) S. RIDEAL, D.SC., (LOND.), F.I.C., F.C.S., Public Analyst, Lewisham District Board of Works.
" 24.	"Inspection and Demonstration of the Disinfecting Station at St. Pancras," at 3 p.m. (Number limited.)
" 24.	"Elementary Chemistry." (Lecture II.) S. RIDEAL, D.SC. (LOND.), F.I.C., F.C.S., Public Analyst, Lewisham District Board of Works.

Oct. 26. "Elementary Bacteriology." R. T. Hewlett, M.D., M.R.C.S.

„ 27. "Inspection of the Aylesbury Dairy Company's Premises, Bayswater."

„ 29. "Ventilation, Warming, and Lighting." Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S.

„ 31. "Inspection and Demonstration of the East London Soap Works, Bow, E."

„ 31. "Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale." H. Law, M.INST.C.E.

Nov. 2. "Water Supply, Drinking Water, Pollution of Water." J. Wallace Peggs, ASSOC.M.INST.C.E.

„ 3. "Inspection and Demonstration of the Wimbledon Sewage Works," at 3 p.m. Conducted by C. H. Cooper, ASSOC.M.INST.C.E., Engineer and Surveyor, Wimbledon Local Board.

„ 5. "Sanitary Building Construction." Keith D. Young, F.R.I.B.A.

„ 7. "Inspection and Demonstration in the Parish of St. George's, Hanover Square," at 2 p.m. (Number limited.) Conducted by Albt. Taylor, Chief Sanitary Inspector.

„ 7. "Sanitary Appliances." Prof. W. H. Corfield, M.A., M.D. (OXON), Medical Officer of Health, St. George's, Hanover Square,

„ 9. "Details of Plumbers' Work." J. Wright Clarke.

„ 10. "Inspection of Harrison and Barber's Knacker Yard, Whitechapel."

„ 12. "House Drainage." W. C. Tyndale, ASSOC.M.INST.C.E.

„ 14. "Inspection and Demonstration of Artizans' Dwellings and Disinfecting Station at Chelsea," at 2 p.m. Conducted by Dr. Louis Parkes, Medical Officer of Health.

„ 14. "Sewerage and Sewage Disposal." Prof. Hy. Robinson, M.INST.C.E.

„ 16. "Scavenging, Disposal of House Refuse." Chas. Mason, ASSOC.M.INST.C.E., A.R.I.B.A., Surveyor, St. Martin's-in-the-Fields.

„ 17. "Inspection of the Southwark and Vauxhall Waterworks, Hampton," at 3 p.m.

„ 19. "Diseases of Animals in Relation to Meat Supply; Characteristics of Vegetables, Fish, &c., Unfit for Food." Prof. A. Wynter Blyth, BARRISTER-AT-LAW, M.R.C.S., Medical Officer of Health for St. Marylebone.

„ 21. "Inspection and Demonstration of the Disinfecting Station, &c., at St. Pancras," at 3 p.m. (Number limited.)

„ 21. "Infectious Diseases and Methods of Disinfection." Edward C. Seaton, M.D., F.R.C.P., Medical Officer of Health, Surrey County Council.

„ 23. "Objects and Methods of Inspection." J. F. J. Sykes, D.SC., M.D., Medical Officer of Health, St. Pancras.

Nov. 24. "Inspection and Demonstration of the Sewage and Destructor Works, Ealing," at 2 p.m. Conducted by **Charles Jones**, M.INST.C.E., Engineer and Surveyor. Ealing Local Board.

" 26. "Nature of Nuisances, including Nuisances the Abatement of which is Difficult." **Arthur Newsholme**, M.D., D.P.H., Medical Officer of Health, Brighton.

" 28. "Inspection and Demonstration in the Parish of St. George's, Hanover Square," at 2 p.m. (Number limited.) Conducted by **Albert Taylor**, Chief Sanitary Inspector.

" 28. "Trade Nuisances." **Prof. A. Bostock Hill**, M.D., D.P.H. (CAMB.), F.I.C., Medical Officer of Health, Aston Rural Sanitary Authority.

" 30. Sanitary Law: English, Scotch and Irish; General Enactments Public Health Act, 1875; Model Bye-Laws, &c." **Prof. A. Wynter Blyth**, M.R.C.S., BARRISTER-AT-LAW, Medical Officer of Health for St. Marylebone.

Dec. 1. "Inspection of

" 3. "Sanitary Laws and Regulations Governing the Metropolis." **Louis Parkes**, M.D., D.P.H. (LOND.), Medical Officer of Health, Chelsea.

LIVERPOOL LECTURES AND DEMONSTRATIONS FOR SANITARY OFFICERS AND OTHERS.

The annexed List of Lectures has been arranged for the special instruction of those desirous of obtaining knowledge of the duties of Sanitary Officers, but will be open to persons of both sexes over the age of eighteen.

The various subjects will be dealt with in a course of Twelve Lectures, given by well-known authorities, and will be illustrated with Diagrams, Drawings and Models.

For the convenience of those who propose to enter for the Examination of the Institute, it may be mentioned that these Lectures will comprise the subjects scheduled for those Examinations.

The course will have a further use in supplying the wants of acting Inspectors and of other persons desirous of obtaining a practical knowledge of Sanitary reguirements and regulations. As a standard of qualification is required by recent legislation, definite knowledge is of great importance to these Officers. At the close of each Lecture Students will be allowed to ask questions upon the subjects treated.

Admission Fee.—A fee of 6s. will be charged for the course to cover the necessary expenses. The Corporation of Liverpool will pay half the Lecture Fees of all Liverpool Corporation Officials who attend not less than two-thirds of the Lectures.

Members and Associates of the Institute can obtain tickets for personal admission on applying to the Secretary of the Institute.

Sept. 29. "Introductory, and on Ventilation, Heating and Lighting." Louis Parkes, M.D., D.P.H., Medical Officer of Health, Chelsea, London.

Oct. 6. "House Drainage and Sanitary Appliances." H. Percy Boulnois, M.INST.C.E., City Engineer, Liverpool.

" 13. "Sanitary Building Construction." T. Harnett Harrisson, ASSOC.M.INST.C.E., F.R.I.B.A.

" 20. "Defects in Plumber's Work." Coard S. Pain, F.S.I., ASSOC.INST.C.E.

" 27. "Scavenging and Disposal of Refuse." E. G. Mawbey, ASSOC.M.INST.C.E., Borough Surveyor, Leicester.

Nov. 3. "Water Supply, Drinking Water, Pollution of Water." Joseph Parry, M.INST.C.E.

" 10. "Diseases of Animals in relation to Meat Supply; Characteristics of Vegetables, Fish, &c., unfit for Food." Francis Vacher, F.R.C.S., F.C.S., Medical Officer of Health, Cheshire County Council.

" 17. "Infectious Diseases and Methods of Disinfection." H. E. Armstrong, M.R.C.S., D.HYG., Medical Officer of Health, Newcastle-upon-Tyne.

" 24. "Powers and Duties of Sanitary Inspectors; Nuisances and Offensive Trades." Philip Boobbyer, M.B., M.R.C.S., Medical Officer of Health, Nottingham.

Dec. 1. "Objects and Methods of Inspection." E. W. Hope, M.D., D.SC., Medical Officer of Health, Liverpool.

" 8. "Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale." W. Goldstraw, Surveyor of Buildings, Liverpool.

" 15. "Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye Laws, &c." Professor A. Wynter Blyth, BARRISTER-AT-LAW, Medical Officer of Health, Marylebone.

In connection with the Lectures, arrangements will be made for the Students to visit various works illustrative of Sanitary Practice and Administration.

CALENDAR FOR OCTOBER TO DECEMBER.

OCTOBER.

1 M. Exhibition Committee, 5 p.m.
6 S. Lecture to Sanitary Officers, Liverpool, 3 p.m.
10 W. Finance Committee, 4 p.m.; Council, 5 p.m.
13 S. Lecture to Sanitary Officers, Liverpool, 3 p.m.
15 M. Education Committee, 5 p.m.
17 W. Lectures to Sanitary Officers, London, 8 p.m.
19 F. Lecture to Sanitary Officers, London, 8 p.m.
20 S. Lecture to Sanitary Officers, Liverpool, 3 p.m. Visit of Students to Mitcham.

22 M.	Lecture to Sanitary Officers, London, 8 p.m. Museum Committee, 5 p.m.
24 W.	Exhibition Committee, 4 p.m. Lecture to Sanitary Officers, London, 8 p.m. Inspection and Demonstration at St. Pancras Vestry.
26 F.	Lecture to Sanitary Officers, London, 8 p.m.
27 S.	Lecture to Sanitary Officers, Liverpool, 3 p.m. Visit of Inspection to Aylesbury Dairy Farm, Bayswater.
29 M.	Lecture to Sanitary Officers, London, 8 p.m.
31 W.	Inspection and Demonstration at East London Soap Wks., Bow, E. Lecture to Sanitary Officers, London, 8 p.m.

NOVEMBER.

1 Th.	Lecture on Sanitation of Industries, London, 8 p.m.
2 F.	Lecture to Sanitary Officers, London, 8 p.m.
3 S.	Lecture to Sanitary Officers, Liverpool, 8 p.m. Inspection and Demonstration at Wimbledon Sewage Farm.
5 M.	Exhibition Committee, 5 p.m. Lecture to Sanitary Officers, London, 8 p.m.
7 W.	Inspection and Demonstration at St. George's, Hanover Square. Sanitary Officers' Lectures, London, at 8 p.m.
8 Th.	Lecture on Sanitation of Industries, London, 8 p.m.
9 F.	Examination Committee, 5 p.m. Lecture to Sanitary Officers, London, 8 p.m.
10 S.	Lecture to Sanitary Officers, Liverpool, 8 p.m. Inspection of Harrison & Barber's Knacker Yard, Whitechapel.
12 M.	Lecture to Sanitary Officers, London, 8 p.m.
14 W.	Finance Committee, 4 p.m. Council, 5 p.m. Inspection of Artisans' Dwellings, Chelsea, 2 p.m. Lecture to Sanitary Officers, London, 8 p.m.
15 Th.	Lecture on Sanitation of Industries, London, 8 p.m.
16 F.	Lecture to Sanitary Officers, London, 8 p.m.
17 S.	Lecture to Sanitary Officers, Liverpool, 8 p.m. Inspection of the Southwark and Vauxhall Water Works.
19 M.	Education Committee, 5 p.m. Lecture to Sanitary Officers, London, 8 p.m.
21 W.	Lecture to Sanitary Officers, London, 8 p.m Inspection and Demonstration at St. Pancras Vestry.
22 Th.	Lecture on Sanitation of Industries, London, 8 p.m.
23 F.	Lecture to Sanitary Officers, London, 8 p.m.
24 S.	Lecture to Sanitary Officers, Liverpool, 8 p.m. Inspection and Demonstration at Ealing Sewage Works.
26 M.	Museum Committee, 5 p.m. Lecture to Sanitary Officers, London, 8 p.m.
28 W.	Inspection and Demonstration, St. George's, Hanover Square. Lecture to Sanitary Officers, London, 8 p.m.
29 Th.	Lecture on Sanitation of Industries, London, 8 p.m.
30 F.	Examination Committee, 5 p.m. Lecture to Sanitary Officers, London, 8 p.m.

DECEMBER.

1 S.	Lecture to Sanitary Officers, Liverpool, 3 p.m.
3 M.	Exhibition Committee, 5 p.m. Lecture to Sanitary Officers, London, 8 p.m.
7 F.	Examination for Inspectors of Nuisances, London.
8 S.	Lecture to Sanitary Officers, Liverpool, 3 p.m.
12 W.	Finance Committee, 4 p.m. Council, 5 p.m. Sessional Meeting, 8 p.m.
14 F. 15 S.	Examination for Inspectors of Nuisances, Cardiff.
15 S.	Lecture to Sanitary Officers, Liverpool, 3 p.m.
17 M.	Education Committee, 5 p.m.
21 F. 22 S.	Examination for Inspectors of Nuisances, Liverpool.
24 M.	Museum Committee, 5 p.m.

FELLOWS, MEMBERS & ASSOCIATES ELECTED.

JULY. (No Ballot held in August and September.)

FELLOWS (FELLOW SAN. INST.)

Reg. No. Date of Election.

646 1894. July. ARMSTRONG, Henry E., D.HYG., M.R.C.S., L.S.A., M.O.H., *The Health Department, Town Hall, Newcastle-on-Tyne.*

714 1894. July. BUTTON, Frederick Smith, ASSOC.M.INST.C.E., *Borough Surveyor,* 13, *Palatine Square (and Town Hall), Burnley.*

675 1894. July. KENWOOD, Henry Richard, M.B., L.R.C.P., D.P.H., F.C.S., M.O.H., 189, *Adelaide Road, Hampstead, N.W.*

MEMBERS (MEM. SAN. INST.)

† Passed Examination as Local Surveyor.

829 1894. July. DEACON, George Frederick, M.INST.C.E., 19, *Warwick Square, S.W.*

830 1894. July. DORMAN, R. H., M.INST.C.E., *County Surveyor, Armagh.*

831 1894. July. †FISHER, Thomas George, 33, *Mount Street, Grosvenor Square, W.*

833 1894. July. GARRETT, Henry Augustus, ASSOC.M.INST.C.E., *Borough Surveyor, Town Hall, Torquay.*

834 1894. July. HILL, Thomas Eustace, M.B., B.SC., M.O.H., 23, *Old Elvet, Durham.*

832 1894. July. †HEBDON, Edward, 11, *Llanion Terrace, Pembroke Dock.*

835 1894. July. †HUNTER, Thomas Briggs, *Grove Road, Windsor.*

836 1894. July. †KILGALLIN, Charles J., *Court House, Marylebone, W. (Abbey Villa, Sligo, Ireland).*

837 1894. July. LATHAM, Albert, M.INST.C.E., *Borough Engineer, Westbourne House, and* 15, *Cecil Square, Margate.*

ASSOCIATES (ASSOC. SAN. INST.)

‡ Passed Examination as Inspector of Nuisances.

960 1894. July. ‡BARNES, John, 47, *Trafalgar Street, Carlisle.*

967 1894. July. ‡BROAD, Charles Cecil, 2, *Norfolk Villas, Abbey Road, Great Malvern, Worcester.*

961 1894. July. ‡CALLIS, John Samuel, 9, *Edgar Street, Jarrow-on-Tyne.*

962 1894. July. ‡HENDERSON, David, 3, *Martin Terrace, Pallion, Sunderland.*

963 1894. July. ‡HOSKINS, George, 13, *Roupell Street, Blackfriars, S.E.*

984 1894. July. ‡Hughes, Robert John, 105, *Claughton Road, Birkenhead.*

985 1894. July. ‡Jackson, Leonard Labrey, *The Dimples, Garstang, Lancashire.*

988 1894. July. ‡Jones, William Henry, 27, *Gordon St., Birkenhead.*

989 1894. July. ‡Jowett, Frederick, *Stockwell Park, Wetherby, Yorkshire.*

993 1894. July. ‡Kendall, Alfred Henry, *Rawdon, Leeds.*

994 1894. July. Morris, Adam, *County Sanitary Inspector, Tweed Bank House, Newtown, St. Boswells, Roxburghshire.*

990 1894. July. ‡Nuttall, Ellis, 50, *Wood Street, Middleton, Lancashire.*

991 1894. July. ‡Rain, Frank Elias, 47, *Amberley Street, Sunderland.*

986 1894. July. ‡Robinson, John, *Neasham Place, Houghton-le-Spring, Durham.*

992 1894. July. ‡Stead, Frederick, *Middleton Tyas, Richmond, Yorkshire.*

CONTRIBUTIONS AND ADDITIONS TO LIBRARY.

June to September, 1894.

⁂ *For publications of Societies and Institutions, &c., see under "Academies."*

ACADEMIES (American).

Manitoba Historical and Scientific Society. Annual Report for the year 1893. 20 p., 8vo. Winnipeg, 1894. *The Society.*

——— The Old Crow Wing Trail, by Hon. J. Schultz. 32 p., 8vo. Winnipeg, 1894. *The Society.*

——— Early Days of Winnipeg, by G. Bryce, LL.D. 8 p., 8vo. Winnipeg, 1894. *The Society.*

——— A Forgotten Northern Fortress, by the Hon. John Schultz. 14 p., 8vo. Winnipeg. *The Society.*

New York. *The American Institute of Mining Engineers.* Transactions, vol. xxii., being Part I. of the Proceedings of the Chicago Meeting of 1893. 795 p., 8vo. New York, 1894. *The Institute.*

——— *The American Institute of Mining Engineers.* Transactions, vol. xxiii., being Part II. of the Proceedings of the Chicago Meeting of 1893. 685 p., 8vo. New York, 1894. *The Institute.*

ACADEMIES (Australian).

New South Wales Royal Society. Journal of Proceedings, 1893, vol. xxvii. 530 p., 8vo. Sydney, 1894. *The Society.*

ACADEMIES (British).

London. *British Association for the Advancement of Science.* Reports for the years 1831-1892 (62 volumes). *Rogers Field, M.Inst.C.E*

——— *Engineers, Society of.* Transactions for 1893, and General Index, 1860 to 1893. 265 p., 8vo. London and New York, 1894. *The Society.*

——— *Middlesex Hospital.* Reports of the Medical and Surgical Registrars and Pathologist for the Year 1892. 378 p., 8vo. London, 1894. *The Hospital.*

ACADEMIES (Continental).

Amsterdam. *Royal Academy of Sciences.* Verslagen der Zittingen van de wis-en Natuurkundige afdeeling der Koninklijke Akademie van Wetenchappen van 27 Mei, 1893, tot 21 April, 1894. 193 p., 8vo. Amsterdam, 1894. *The Academy.*

——— *Royal Academy of Sciences.* Etude sur les vibrions Cholériques isolés des déjections et rencontrés dans les eaux en Hollande pendant les épidémies de 1892 et 1893, par le Dr. C. H. H. Spronck. 54 p., 8vo. Amsterdam, 1894. *The Academy.*

——— *Royal Academy of Sciences.* Die Erscheinungsweise der Sauerstoffausscheidung Chromophyllhaltiger Zellen im Licht bei Anwendung der Bacterienmethode, von. Th. W. Engelmann. 10 p., 8vo. Amsterdam, 1894. *The Academy.*

——— *Royal Academy of Sciences.* Over den invloed der Ademhaling op de verplaatsing van suiker, vet en eiwit door Dr. H. J. Hamburger. 35 p., 8vo. Amsterdam, 1894. *The Academy.*

——— *Royal Academy of Sciences.* Een Lymphdrijvende Bacterie door Dr. H. J. Hamburger. 27 p., 8vo. Amsterdam. *The Academy.*

——— *Royal Academy of Sciences.* Onderzoekingen over de Lymph door Dr. H. J. Hamburger. 36 p., 8vo. Amsterdam, 1893. *The Academy.*

Rome. *R. Universita' di.* Annali dell' Istituto d'igiene sperimentale. Vol. IV. (nuova Serie) Fasc I. 144 p., 8vo. Rome, 1894. *The Institute.*

Ball, *Prof. Valentine.* An Address to the Museums Association on the Museums of Dublin. 21 p., 8vo. Reprint from Natural Science, July, 1894. *The Author.*

Bechmann, *M. George.* Address to the Sanitary Inspectors' Association, April 7th, 1894. 11 p., 8vo. London, 1894. *The Author.*

Board of Agriculture. Annual Report of the Director of the Veterinary Department for the year 1893, with an appendix. 142 p., 8vo. London, 1894. *The Board.*

Cornil, *M.* Rapport fait au nom de la Commission chargèe d'examiner le projet de loi, adopté par la Chambre des Députés, relatif à l' assainissement de Paris et de la Seine. 53 p., 4to. Paris, 1894. *George Bechmann.*

Delano, *W. H.* Twenty years' practical experience of natural asphalt and mineral bitumen. 73 p., 8vo. London and New York, 1893. *The Author.*

Fawcett, *E. A. Sandford.* The Sanitary Engineers' Pocket Report Book. p., 8vo. London, 1894. *The Author.*

Gillespie, *Rev. C. G. K.* The Sanitary Code of the Pentateuch. 96 p., 16mo. London, 1894. *The Author.*

Glasgow Sewage Disposal Works. 12 p., 4to. Reprinted from "The Engineer," Jan. 19th and May 4th, 1894. *Drysdale & Co.*

Greenwich. *The Royal Observatory.* Results of the Magnetical and Meteorological Observations made at, in the Year 1891. 157 p., 4to. London, 1893. *The Astronomer Royal.*

Hodgson, *George.* Report on the Epsom Water Supply. 29 p., f.cap. London, 1894. *The Author.*

Italy. *Ministère de l'Interieur du Royaume d'Italie.* La Législation et l'Administration Sanitaire en Italie et les Institutions Scientifiques annexées á la Direction de la Santé Publique. 126 p., 8vo. Rome, 1894. *Dr. Dawson Williams.*

——— Guide des Thermes et Bains d'Italie. 176 p., 8vo. Turin, 1894. *Dr. G. S. Vinaj.*

Jacobi, *Dr. A.* "Non Nocere." 36 p., 16mo. Reprint from the "Medical Record," May, 1894. *The Author.*

Johnston, *Surgeon-Major H. H.* Report on the relation between Malarial Fever among Her Majesty's White Troops at Port Louis, Mauritius, and the Meteorological Elements of Temperature, Rainfall, and Relative Humidity for the year, 1889; with a preliminary sketch of the Medical Topography of the Island, and the Epidemic of Malarial Fever in 1866-67. 47 p., 8vo. Edinburgh, 1894. *The Author.*

——— On the relative efficiency of certain Filters for removing Micro-Organisms from Water, with special reference to the Nordtmeyer-Berkefeld and Pasteur-Chamberland Filter. 48 p., 8vo. Edinburgh, 1894. *The Author.*

Local Government Board. Twenty-second Annual Report, containing the Report of the Medical Officer for 1892-93. 462 p., 8vo. London, 1894. *The Board.*

——— Mr. Evan Evans' Report on an Outbreak of Enteric Fever at Pocklington, Yorks. 9 p., f.cap. London, 1894. *The Board.*

——— Mr. Evan Evans' Report upon the Sanitary condition of the Uxbridge Rural Sanitary District. 16 p., f.cap. London, 1894. *The Board.*

——— Dr. R. Bruce Low's Report on the Water Supply of the Penrith Urban Sanitary District. 12 p., f.cap. London, 1894. *The Board.*

——— Dr. Bruce Low's Report on the General Sanitary Circumstances of the Ystradfodwg Urban District and upon Administration by the Sanitary Authority. 19 p., f.cap. London, 1894. *The Board.*

——— Dr. R. Bruce Low's Report on an Outbreak of Anomalous Illness characterised chiefly by Broncho-Pneumonia and Sore-Throat in the Parish of Laxfield, Suffolk. 15 p., f.cap. London, 1894. *The Board.*

Local Government Board. Dr. Theodore Thomson's Report on Cholera in the Borough of Rotherham, 1893. 7 p., f.cap. London, 1894. *The Board.*

——— Dr. Theodore Thomson's Report on an Epidemic of Enteric Fever in the Borough of Worthing and in the Villages of Broadwater and West Tarring. 31 p., f.cap. London, 1894. *The Board.*

McNally, *Surg.-Maj. C. J.* Sanitary Handbook for India. 267 p., 8vo. Madras and London, 1889. *The Author.*

Mansion House Council on the Dwellings of the Poor. Report for Year 1893. 86 p., 8vo. London, 1894. *The Council.*

ANALYSTS', MEDICAL OFFICERS', SANITARY INSPECTORS', AND SURVEYORS' REPORTS.

Birkenhead, 1893	*Dr. R. S. Marsden.*
Birmingham, 1893	*Dr. Alfred Hill.*
Bolton, 1893	*Dr. F. E. Adams.*
Cardiff, 1893	*Dr. E. Walford.*
Chester C. C., 1893	*Francis Vacher.*
Dalton-in-Furness, 1892	*C. C. Smith.*
Dublin, 1893	*Sir C. Cameron.*
Dunbarton C. C., 1893	*D. Dunbar.*
Durham C. C., 1893	*Dr. T. Eustace Hill.*
Hastings, for Quarter ending June 30, 1894	*Dr. A. S. Wilson.*
Hull and Goole Port Sanitary Authority, 1893	*Dr. J. W. Mason.*
Kensington, 1893	*Dr. T. Orme Dudfield.*
Lambeth, Parish of, 1893	*J. Baxter.*
Liverpool, 1893	*Dr. E. W. Hope.*
Newcastle-upon-Tyne, 1893	*Dr. H. E. Armstrong.*
Nottingham, 1893	*Dr. P. Boobbyer.*
Poplar District B. W., 1893	*The Board.*
Toxteth Park Local Board, 1893	*Dr. G. W. Steeves.*
Wolverhampton, 1893	*Dr. H. Malet.*
Wandsworth District B. W., 1893	*The Board.*

New Hampshire State Board of Health. Annual Report for the year 1893. 284 p., 8vo. Concord, 1893. *The Board.*

New South Wales. *Metropolitan Board of Water Supply and Sewerage.* Sixth Annual Report, being that for the year 1893. 89 p., maps and plates, f.cap. Sydney, 1894. *Agent-General for New South Wales.*

——— *Department of Public Works.* Report of the Department for the year 1892. 161 p., maps and plates, f.cap. Sydney, 1893. *Agent-General for New South Wales.*

Nyland, *J.* Report on the Social Condition of the People. 8 p., 8vo. London, 1894. *The Author.*

Ottawa. *Inland Revenue Department.* Bulletin No. 38. "Wines." 27 p., 8vo. Ottawa, 1894. *The Department.*

Pim, *F. W.* The Health of Dublin, being Three Addresses, viz.:—The Growth of Sanitation in Dublin. A Sketch of the Sanitary Progress in Dublin. Preventible Diseases; Why are they not Prevented? 92 p., 16mo. Dublin, 1890-91-92. *The Author.*

Rome. Le Acque potabili di Albano Laziale. 19 p., f.cap. Rome, 1894. *Ministero dell' Interno.*

——— Circa i fatti principali riguardanti l'igiene e la Sanità Pubblica nel Regno nel primo semestre dell' anno, 1894. 14 p., f.cap. Rome, 1894. *Ministero dell' Interno.*

——— Relazione intorno all'Epidemia di Colera in Italia, nell'anno, 1893, per il Prof. L. Pagliani. 29 p., fcap. Rome, 1894. *Ministero dell' Interno.*

——— Della Cultura del Diplococco di Fraenkel nelle uova, nota del Dott a Sclavo. 3 p., f.cap. Rome, 1894. *Ministero dell' Interno.*

St. Pancras. Report upon the Cause of the Increase of Mortality from Diphtheria in London. By Dr. J. F. J. Sykes. 19 p., 4to. London, 1894. *The Author.*

Silk, *A. E.* A Report on the Water Supply System of the City of Berlin. 14 p., maps, f.cap. Calcutta, 1894. *The Author.*

Silk, *A. E.* A Report on the Drainage and Sewerage System of the City of Berlin. 35 p., maps, f.cap. Calcutta, 1894. *The Author.*

Simla Municipality. Annual Report for the year 1893-94. 55 p., 8vo. Simla, 1894. *A. Hale.*

Smith, *C. C.* Intercepting Traps. 8 p., 16mo. Reprint from *The Sanitary Record*, 1891. *The Author.*

Smith, *C. C.* Some Defects in the Public Health Act, 1875. 24 p., 32mo. Reprint from *The Sanitary Record*, February and March, 1890. *The Author.*

Smith, *C. C.* House Refuse: Its Collection, Removal and Disposal. 8 p., 8vo. Reprint from *The Sanitary Record*, April 15, 1891. *The Author.*

Smith, *J. McGarvie.* Investigation of the Composition of the Air in the Sewers of Sydney, with special reference to the Presence of Germs. 11 p., f.cap. Sydney, 1893. *The Author.*

Surveyors, *Association of* (or the *Royal Engineer Establishment*). Occasional Papers, 1894. 68 p., 8vo. Devonport, 1894. *The Association.*

Twining, *T.* Primary Science, being a Pedagogic Treatment of the Science of Common Things. 20 p., 8vo. Twickenham, 1894. *The Author.*

Wallis-Tayler, *A. J.* The Sanitary Arrangement of Dwelling Houses. 196 p., 8vo. London, 1894. *The Author.*

Waring, *Col. G. E. (Jun.)* Modern Methods of Sewage Disposal for Towns, Public Institutions, and Isolated Houses. 252 p., 8vo. London and New York, 1894. *The Author.*

Worthing. Report on the Epidemic of Enteric Fever in 1893, by Dr. C. Kelly. 59 p., 8vo. Plates. Brighton, 1894. *The Author.*

Volume XV.—Part IV.] [January, 1895.

JOURNAL
OF
THE SANITARY INSTITUTE.

CONGRESS AT LIVERPOOL.

SECTION I.
SANITARY SCIENCE & PREVENTIVE MEDICINE.

PAPERS AND DISCUSSIONS.

On "*Infant Mortality and Female Labour in relation to Factory Legislation*," *by* GEORGE REID, M.D., Medical Officer of Health, Staffordshire County Council. (FELLOW).

BY the infant death-rate of a community is meant the number of deaths of children under twelve months of age which occur during one year, as compared with the number of births registered during the year, and the figures are usually expressed as so many deaths per 1,000 births.

When a layman is told that in England among every thousand infants born 142 die during the first year of life, he can hardly credit the statement; and when he is further asked to believe that the mortality among a given number of infants born in certain artisan towns exceeds by more than 100 per cent. the mortality among a corresponding number of infants born in agricultural counties, he is still more amazed. Yet such is the case, and when we consider that the mortality even in rural districts must to a large extent be attributed to causes which are preventable, the gravity of the question as to the remedial measures which are called for is impressively apparent.

It will not be disputed that the chief causes which conduce to a high infant mortality are insanitary surroundings and ignorance. The remedy as regards the former, except, perhaps, so far as personal cleanliness is concerned, rests in a large measure with the Public Health Authorities, and, on the whole, I think they are progressing as fast as can reasonably be expected. The same cannot be said, however, regarding the latter, for children are still allowed to grow up in complete ignorance of the simple health principles which should guide them in after life. It is almost incredible in these educational days that the subject of elementary hygiene is still omitted from the curriculum of our elementary schools. Sooner or later, no doubt, it will be introduced, but until it is, ignorance will continue to operate in maintaining the high infant mortality of the country.

My object on this occasion, however, is not to discuss the general question of infant mortality, but to call attention to one phase of it, namely, the influence which the practice of young mothers engaging in factory work has in maintaining the excessively high infant mortality rates of many of our artisan towns; and, especially, to consider whether a practicable remedy can be found to correct what appears to be a very serious evil.

My attention was first specially called to the bad effects resulting from the practice of mothers working in factories, as regards the lives of their children, about five years ago, when I began to collate the reports of the various Medical Officers of Health in Staffordshire for the information of the County Council. Two facts were very apparent, first, that in certain towns the infant mortality was abnormally high; and secondly, that the towns in which the highest mortality prevailed were mostly situated in the north of the county. At first I had not sufficient personal knowledge of the districts to enable me to form an opinion as to the possible explanation of this, but I afterwards satisfied myself that it was not to be attributed to any appreciable difference in local conditions.

The county is divided into two populous areas, one in the north and the other in the south (central Staffordshire being mainly rural). Both the northern and southern groups of towns are practically identical as regards sanitary conditions, but in one respect they differ, namely, in the nature of the trade carried on. Whereas in the south the people are mostly engaged in coal mines and iron works, in the north the chief industry is potting. To this circumstance I concluded—rightly as it turned out—the high infant mortality in the north of the county, as compared with the south, was to be attributed, for in the potting industry of the north there are many married women workers, whereas in the mining and iron industries of the south this is not the case to any appreciable extent.

To test the accuracy of this theory, it was necessary to obtain statistics covering a longer period than those already in my possession, and as the trade distinction between the north and south did not hold good in all cases, the towns—all of them artisan—were grouped, not according to locality, but in accordance with the industry carried on in each.

From information derived from the various Medical Officers of Health, amplified in certain cases by further details from employers of labour, the industrial towns were classified as follows:—(1) Towns in which married women are largely employed in work; (2) Towns in which married women are engaged to a less extent in work; and (3) Towns in which few married women are engaged in work. In the first group were placed those towns where one chief industry is in operation in which married women are largely engaged; the second group comprised those towns in which different industries are carried on, in some of which married women are employed in considerable numbers; and in the third group were placed those towns where the industry or industries do not admit of the employment of married women.

The conclusions arrived at as the outcome of this inquiry, which embraced a population of upwards of 430,000, and in the case of most of the towns covered a period of ten years, have already been made public; for my present purpose, therefore, a summary of them will suffice.

As regards the infant death-rate, it was found that in the first group of towns, namely, where married women are largely engaged in factories, &c., 195 children died during the first year of life in every thousand born, as compared with 152 in the third group, which embraced towns where practically no married women are engaged. In other words, 28 per cent. more infants died in the former than in the latter. Again, in the second group, consisting of those towns intermediate between the other two as regards the number of married women engaged in work, the figures were 166, a decrease of 15 per cent. as compared with the first group, and an increase of 9 per cent. as compared with the third.

It follows from these figures, if they bear the interpretation placed upon them, that no fewer than 2885 infants died in Staffordshire during the ten years covered by the inquiry who need not have died; in other words, the employment of young married women in factories or away from home is responsible, in one county, for nearly 300 deaths annually among infants under one year.

As the outcome of a paper I read upon the subject at the annual meeting of the British Medical Association in 1892, an inquiry on similar lines, but embracing the whole of England, was instituted by the Parliamentary Bills Committee of the Association, the result of which is shown in the table, together with the Staffordshire figures:—

	GROUP I. Many married women engaged.	GROUP II. Fewer married women engaged.	GROUP III. Practically no married women engaged.
Staffordshire	195	166	152
Percentage increase compared with Group III.	28	9	...
England	179	159	152
Percentage increase compared with Group III.	18	5	...

You will notice that, with the exception of the third group of towns, the figures for Staffordshire are higher than those for England, also that the divergent result is more pronounced in the former case than in the latter. The probable explanation of this is, that in the larger inquiry the grouping of the towns was less carefully done than was the case in the Staffordshire inquiry, in which infinite trouble was taken in every case to arrive at a true classification. Be this as it may, however, I think you will agree with me that in both cases the result is sufficiently startling to warrant some action being taken with the view of correcting what is undoubtedly a serious evil.

Statistics conclusively show that the mortality among artificially fed infants is very much greater than among infants fed even partly on breast milk, and I believe this is the chief, if not the only explanation of the high infant mortality in the towns classified under the first group in the table.

What remedy then can be suggested?

In the first place, let me point out that the law does provide some amount of protection by pronouncing it to be illegal for a mother to return to work under one month after the birth of her child, so that, in asking for some more efficient remedy we cannot be accused of overstepping the limits of the recognised legislative sphere. If legislation interferes at all, why should not the interference be as effective as is reasonably possible? It amounts to this, then, as the care of her children is a mother's first duty, those mothers who have young children must be restrained from engaging in work which takes them away from home, unless they can show that satisfactory provision has been made for their children being cared for during their absence. Under any circumstances, it is a question whether it would not be desirable that the period of one month's enforced absence from factory work after the birth of a child should be extended to three months.

Let us consider these two questions from a practical point of view.

Taking the last first, and granting that it is not feasible to prevent young mothers from working in factories, there can be no question that it would be to the advantage of the infant if the mother remained at home for three months after its birth. Some assert, however, that such a change in the law would have the effect, practically, of excluding married women from factory work, owing to their places having been filled up during their long absence. As regards this, I have the assurance of one who is thoroughly familiar with the question of female labour in Lancashire, that, in many cases, it has resulted from the imposition of the one month's absence required by the present Factory Act, so that the injury, if it be an injury, has already, at any rate to a considerable extent, been brought about.

I am not sure, however, if my alternative suggestion were carried out, that it would not be better for the infants to be placed under experienced care, and judiciously fed on artificial food from the start, rather than leave them to the indifferent care they are likely to receive from the present race of mothers.

Of course artificial feeding in accordance with proper principles would be a very different thing to such diet as infants are reared on by ignorant mothers and irresponsible persons to whom they may be entrusted, and although breast milk is the natural and proper food for infants, it by no means follows that it could not be replaced by a wholesome substitute, under intelligent management, without inflicting serious injury. I have visited many existing crêches, and can testify to the happy contrast, evident to the most casual observer, between the infants reared in such institutions, and those whose hard lot it is to struggle against the evils of artificial feeding at home. This is not surprising when we consider the fate of the infants in the one case and in the other.

Now I am aware that circumstances often render it essential for mothers to work in order to maintain their families, but how much oftener is it the case that the wife goes to work while at the same time the husband is earning ample wages. I am told that in Lancashire it is common for a man to receive 25s. a week, while his wife earns from 15s. to 20s.; and I know that in Staffordshire, when the potting trade is ordinarily prosperous, the weekly wages of a man and his wife often amount to 30s. and 12s. respectively; many of the men-workers receive much higher wages, but the figures given in both cases represent a fair average. As a rule every farthing of this money is spent, but little of it goes to feed and clothe the children. Too often the wife has to keep the family out of her earnings, whilst the husband spends most of his in drink.

Is this condition of things to be allowed to continue?

A short Act of Parliament—adoptive, if you like—enabling Local Authorities to establish crêches in districts where it is the common practice for mothers to work in factories, is, in my opinion, the only means under existing circumstances, by which the sacrifice of infant life consequent upon factory labour can be prevented. I do not mean that the expense attending the establishment of these institutions should be provided out of the public funds, but that, as far as possible, they should be self-supporting. It is surely not unreasonable to expect that mothers who disregard their maternal responsibilities in order to supplement the already ample earnings of their husbands, by engaging in work away from home, should part with a portion of the money they receive to provide for the proper care which their children are thus deprived of. Under present conditions payment is made, in most cases, to persons who take charge of the children during the mother's absence, and if an increased payment was made to an institution under public control, children would then be properly looked after and fed. In a certain number of cases, no doubt, the whole or a portion of the payments would have to be defrayed out of the rates, but in the vast majority no such help would be called for. I have endeavoured to ascertain the probable charge it would be necessary to make, but the existing crêches are supported very largely by charity, and it is difficult to arrive at the actual expenditure. On the whole, however, from what I have seen of the statements of accounts of some of these, I believe a payment of about 3s. a week for each child is pretty near the mark.

In these days of state philanthropy it is remarkable that so little has yet been done by the legislature to correct the evil which is the subject of this paper; that while every effort is being made to shield adult life from the risks attending many of the trade processes, thousands of infants are allowed to die annually from starvation (I mean starvation from want of proper food) among families whose weekly earnings are double if not treble those of the rural labourer. It is true the law punishes parents who ill-treat and deliberately starve or neglect their children, but such cases are few and far between compared with the wholesale destruction of infant life which results from the practice of mothers neglecting their home duties in order to add to the weekly earnings of their husbands, earnings which, as a rule, if judiciously spent, would be sufficient to meet necessary expenses. To the infants of such parents the State says, if for a few years you can manage to survive the perils to which you are exposed, we shall then provide you with food for the mind, but we do not recognise it as part of our business to see that your parents afford you a reasonable chance of survival until then. We shall endeavour, meanwhile, to insure that your sanitary surroundings are reasonably respectable, and if it comes to our knowledge that you suffer from any deliberate act of cruelty, or that food of some sort is not provided for you, we shall come to your assistance, but here our interference must end. If your parents, for purposes of their own, disregard their responsibilities and leave you to the tender mercies of some irresponsible person, so long as you are not subjected to deliberate acts of cruelty or neglect, we cannot interfere.

The British Medical Association, through their Parliamentary Bills Committee, propose soon to approach the Government, in order to bring to their notice the facts I have dealt with, in the hope that some legislative enactment may be passed on the lines I have indicated, and it is most desirable that the movement should be supported by public opinion, hence the reason for my introducing the subject on this occasion, in compliance with the special request of the Chairman of the Council of the Institute. If the same amount of influential energy had been brought to bear on the question as was exerted some years ago in a fruitless effort to remedy the exaggerated evil of life insurance, I fully believe a remedy would ere this have been arrived at, which would have saved more lives in one year than the restriction or abolition of infant insurance could have effected in a century.

Dr. J. **Brown** (Bacup) said that most of those medical officers who were engaged in manufacturing towns in Lancashire were perfectly cognisant of the evils which caused the high rate of infant mortality. Speaking as a Medical Officer of Health of North East Lancashire for seventeen years, he felt that the sacrifice of the "innocents" was something lamentable. He had not worked out the groups in the way Dr. Reid had done, but the death-rate in Bacup was not quite so high as that given for Staffordshire, and he was confident it was a subject which ought to be dealt with by the Legislature, although he did not know whether the passing of a Bill which might be adopted was the wisest plan or not. They had already a large amount of legislation of that character, and some medical officers in endeavouring to get some Acts adopted, had found that certain Sanitary Authorities were slow to avail themselves of them. In his opinion it would be far better if an Act could be tested in certain towns where female labour was very prevalent, in order to see what the result would be. He had no doubt the infantile death-rate would be very much reduced, and that ultimately they would elevate public opinion, so that the Act would be made compulsory all over the kingdom. In Lancashire, it must be admitted that infants started with a lower vitality than those in rural districts, and that the crowding of houses upon land was one of the predisposing causes of this high infant mortality. He did not know whether or not in Lancashire the insurance of infant children conduced somewhat to the heavy mortality, but certainly that was a question which required investigation.

Dr. Holden (Mayor of Preston), said he came from a town which had the highest death-rate in the Kingdom. Naturally having been connected with the Sanitary Committee of that town for many years, his attention would be directed to the matter of infantile mortality. Personally he was in favour of extending the compulsory period before a mother could resume work from one month to three months. And the remedy which had been suggested to him was that masters and employers of labour should provide rooms in their mills and workshops where women were employed, in which they should have certain diet tables and diets provided suitable for children of all ages. That was to say that milk and artificial foods should be mixed in such proportions as were suitable to the digestive power of children at various ages. These rooms would have a good effect in another respect, as they would enable those mothers who were suckling their children to visit them at stated intervals. He might add that the Medical Officer of Preston some years ago pointed out that amongst children of the Irish population, the infantile mortality from diarrhœa was almost non-existent, while amongst purely native population the mortality from that disease was frightful. That went in a great measure to support the theory enunciated by Dr. Reid that the death-rate was due largely to the low state of vitality of workers whose relations had been employed in factory work for several generations.

Dr. Wheatley (Blackburn) said his principal excuse for addressing a few remarks to the Section was that his town had the unenviable reputation of having one of the highest infantile mortalities of any of the large towns in England. Curiously enough taking the average mortality for the last eight years it came to exactly the same figure, 195, as Dr. Reid's mortality in group No. 1. It was very seldom that the infantile mortality for Blackburn was much below 200; last year it was very considerably above. He was led to enquire as to the cause of this and he came to the same conclusion as Dr. Reid—that the employment of married women in the factories was by far the most important cause of the high infantile mortality. He was sorry that the Registrar-General in the census returns did not supply the number of married women employed in the different trades. He, however, found that Blackburn had a higher percentage of women employed in cotton mills than any of the other towns, and also that it had a smaller percentage of women without any occupation. There were only 37 per cent. of women in Blackburn over fifteen years of age who had no occupation whatever and stayed at home to attend to their duties, while nearly 50 per cent. of the women were employed in the cotton mills. This was an enormous percentage, especially when we consider the low ages at which females in cotton towns usually marry, a large percentage of women over eighteen or nineteen being married. In Blackburn a crêche was formed eight or ten months ago and the women paid 2s. 6d. a week for each child, but he thought it was found that the cost was about 5s., the expenditure being almost double the income. With regard to the compulsory month, although it might be a considerable help to the mother, it could not affect infantile mortality, seeing that the great mortality except in cases where death occurred on the first or second day after birth, was after the month had passed. Until the period was extended to six months or the feeding and the training of the children were undertaken by the State he did not think very much could be done to diminish infantile mortality.

Dr. E. Sergeant (M.O.H. to the Lancashire County Council), remarked that Dr. Reid had paid great attention to this snbject, which was of very great importance in manufacturing districts. He quite agreed with the remarks that had been made as to the feeding of children and the necessity of seeing that they were properly nursed in crêches, but he felt very strongly upon the necessity for more care being taken with respect to the parents themselves. Young people in the manufacturing districts got married much too young, and early marriages, he thought, had a great deal to do with this infantile mortality. It was not uncommon for a young man of eighteen or twenty who was receiving probably 15s. a week to marry a young woman of the same age who also worked in the Mill and received another 15s. a week. One could quite understand that for a brief period their establishment could be kept going, but immediately a family began to form, privations resulted. If these young women were kept from working in the Mill, more than say three months, he was afraid the poverty which would ensue would cause greater evil than allowing them to work at the Mills. In his experience there was too much personal uncleanliness amongst people in manufacturing and colliery districts; one found the greatest filth of person, of house, and of food. Another question he desired to ask was, did the mothers, who remained at home and were supposed to look after their children, really look after those children? From what he had seen in towns where infant mortality was greatest, the mothers did not look after their young children as they ought to do. If one went into the street immediately a crowd of women came to their doors and gossiped as to what was being done. Of course their husbands were at work. Gossiping continued until practically the time the husband was expected home, and only then did it occur to them that they must prepare dinner. This was prepared in about five minutes, with the result that the husband probably got an attack of dyspepsia and became in a very bad humour, and when he returned from his work in the evening, he went to some place where he could get liquid refreshment and gossip on his own account. How this want of attention on the part of young mothers could be avoided he did not know; possibly education of the young would be an advantage. It was possible also that lady missionaries might induce the young mothers to pay more attention to their children, but it would be some time before it would be of any effect because it was so ingrained in their systems that he was afraid it would be difficult in this generation to get rid of such tendencies. Another suggestion which had arisen in his mind was that prizes might be offered for cleanliness of houses. He would not say cleanliness of person because he thought that would follow upon the other. This would induce a spirit of emulation, and in course of time there might be some improvement on the unfortunate condition of many houses in manufacturing towns.

Dr. J. T. ARLIDGE (Stoke-upon-Trent) said that soon after he went into the Pottery District, thirty years ago, he examined the question of the great mortality of infants. At the time his impression was that the chief cause of the great mortality was the improper feeding of infants, and various collateral sanitary causes connected with the social state of the people. Dr. Reid had done good service by clearly unfolding the fact that the employment in factories of married women having infants was a leading cause of that great mortality. There is, however, no cause that acts alone where social problems are in question. With regard to the question of feeding, he found that mothers placed their children out with some neighbour, or an old woman who made it a business, at a penny or so a week to take charge of infants while the mothers were at work. These unfortunate infants were usually fed on bread and water, and the cause of the great mortality was consequently very patent. The question arose how to prevent this? Dr. Reid proposed that mothers should not return to work for three months after confinement; that was a very long period; and Dr. Arlidge did not think our legislators could go much beyond the month already prescribed by the Factory Acts. The absence of the mother from work implied loss of wage which would entail suffering in the family, and it would really become a question whether the health of the mother or of the last comer into the world was to be sacrificed, forasmuch as wages were not so high that the loss of the woman's earnings would have no effect. What was wanted was to secure sufficient means of feeding the whole family, infants as well as all others. Young women employed in factories commonly married very early, and as a rule had not the least notion of cooking. He considered it was a very good suggestion that in large factories there should be dining-rooms where provision might be made and diet prepared by a cook employed for the office and where both mother and child might get proper nourishment. That, however, would be impracticable in many factories which only employ a small number of hands, and whose owners could not be expected to build dining-rooms and provide a qualified cook to prepare victuals. As to the provision of crêches, one was established many years ago in one of the principal towns in the Potteries, but mothers did not seem to care to take their children there and the movement collapsed in the course of a year or two.

Dr. R. S. MARSDEN (Birkenhead) pointed out that Dr. Reid's proposal, if carried out, would, to some extent, again interfere with the liberty of the subject by Act of Parliament, and a crusade of this kind meant entering upon a very wide subject, which would arouse a considerable amount of popular hostility, and might be far reaching in its effects upon other sanitary improvements. The provision of public crêches was an economic question, and if they were to be maintained out of the rates, the long-suffering ratepayers would kick against the charge, as the accumulation of public sanitary improvements requiring to be paid for out of the ratepayer's pockets, had become so great now, that he was afraid the ratepayers would not go to the extent of public crêches, when it was the duty of parents themselves to provide for their children. On the ethical side of the question, everyone of them must agree with the remarks of Dr. Reid.

Alderman BOULTON (Chairman of the Burslem Sanitary Authority) said the body to which he belonged had made a strict examination to see whether any foul means were used whereby they could account for the lamentable death-rate among infants, but they could find nothing to support that theory. It seemed to them that it resulted from the children being put out to nurse, and not being properly attended to by the mothers. He was convinced that if they, as a Congress, or as individuals, could do something to lessen the facilities for obtaining drink, they would be doing a great service.

Miss ANNESLEY KENEALY (Watford) said it appeared to her that in this discussion of a woman's question, the gentlemen present had been regarding it too much from one point of view. A strong indictment had been brought against the women of the working class, that they did not care about their children and spent all their time in gossiping. That was a little hard, and she was going to show that after all even if they were guilty it was very largely owing to defects in man's legislation. There were two points which very strongly suggested themselves to her. If a woman was to be a wage earner she must in some way or other be relieved of the active responsibility of motherhood; if she was to be a good and true mother she must in some way be relieved of the responsibility of wage earner. Now, would they accomplish that best by abolishing the labour of married women or by inducing men to spend less of their wages in the public-house, so that the income would not need supplementing by the earnings of the wife. The suggestion that in all factories and workshops where married women were employed, there should be a room to which infants might be brought so that their mothers might administer the natural nourishment of babies, did not commend itself to her at all. It appeared to her that if a woman was exhausted, as she must be, by the hard labour of factories, she was not in a condition to give suitable nourishment to her child. Exhausted motherhood could neither produce nor maintain fine types of humanity, and for this reason she always felt individually that married women should not be wage earners. But it was a question that could not be entirely met by Legislative Acts. At the same time it would perhaps be rather hard on some of the young factory women if a rule were made that marriage should debar them from work in the factories, because she understood that as a result they would not have nearly so many chances of getting married. One of the chief causes of early and improvident marriages among mill and factory operatives, was that a young man incurred so little responsibility in marriage when his wife could earn perhaps as much as himself. She thought some of the speakers had been very hard on the working classes in condemning their "gossip," for after all it was the only social life they had. With regard to the ignorance of cookery and domestic economy dwelt on by some of the speakers, that was clearly a condition of things for which men were responsible. She was very much interested in Technical Education, and had recently been looking over the list of subjects taught in various countries under committees of men. She noticed that man-like they invariably appropriated to classes which could only be of benefit to men the lion's share of the grants made under the Technical Education scheme. She would express a hope that in the near future Technical Education committees should consist of an equal number of men and women, and that could only be accomplished by removing the disability of women to serve on County Councils and other legislative bodies. Until that time arrived, the questions that they had been discussing would never be properly solved, because at present only half humanity was represented. Perfect legislation would never be accomplished until they had perfect union of the masculine and feminine mind, and a blending of their interests.

Dr. J. F. J. SYKES (St. Pancras) said he had thought the matter out from a logical point of view. A point which struck him was this, that Section 17 of the Factory Act under which an employer should not knowingly allow a woman to be employed within four weeks after the birth of her child, was passed specially for the protection of the woman, and not for the protection of the child. There was no legislation whatsoever for the protection of the health of infants, and it was a question for everyone interested in the subject to decide whether the health of infants should be considered in legislation. For one, he said decidedly, "Yes." A normal infant should be suckled at least six months after birth by the mother. That was a physiological fact; and another fact, though not physiological, was that most mothers in factory districts, whether they worked in factories or not, did not suckle their infants for six months. Therefore, whether a mother went into or kept outside a factory did not affect the question of infants being nursed at the breast. He thought everybody would agree with Dr. Marsden, that Local Authorities would not undertake such a task as providing public crêches. That, however, could be got over, because if once they compelled the mother before entering on work in a factory to produce to her employer a certificate that her infant was properly cared for during her absence they solved the difficulty. He was quite sure if an adoptive Act to that effect were passed, it would produce no hardship whatever; rather would it compel parents to make proper provision by co-operation for the nursing of children. He thought that line of action would certainly do more good than any other course which had been suggested, and for his own part he could not see any objection to a mother being compelled to produce such a certificate. He was asked who was to give the certificate, that would be a very simple matter. It was only a question of being signed by a householder, a district visitor, or by any responsible person of the kind.

Mr. A. E. **Eccles** (Member Chorley Rural Sanitary Committee) said he did not see a better way of meeting the difficulty than by placing this matter in the hands of Inspectors of Factories, but they would require more female inspectors if this matter had to be attended to properly. At shareholders' meetings he advocated the provision of dining-rooms, and after forty years' experience of the working classes of Lancashire as an employer he felt sure that they would have to provide more accommodation than they had done for the work-people if decency and health had to be promoted.

Dr. **Charles Porter** (Stockport) remarked that in the town with which he was connected the infant mortality was extremely high, the deaths under one year of age for 1893 constituting nearly one-third of the whole number of deaths. There could be no doubt whatever of the effect of the employment of women in factories, but it struck him that any alteration in the law as regarded the time at which women could return to work should be in the direction of the prohibition of work *before* confinement rather than *after* it, as a very large proportion of infant deaths occurred during the first month of life from causes amounting to prematurity and low vitality at birth, the result, probably, to a considerable extent of the employment of women during pregnancy. Personally, he thought a period of two months' prohibition after labour desirable and justifiable, as the first two months were by far the most fatal to infant life, and as regards the mothers this period was the time usually occupied by the process of uterine involution. Extension of the period of prohibition, however, was surrounded by social and economic difficulties which it was almost impossible to get over. It was all very well to say men were drunkards. No doubt they were horribly drunken and lazy in a good many cases, but there were numbers of others who could not get work. Women's labour was cheaper than men's labour, and very often the only source of income was the money earned by women.

If, therefore, they cut off the only source of supply, it was a question on the one hand of possible neglect of the infant, and on the other hand of practical starvation. Strange as it might seem it was nevertheless true that many mill-managers and over-lookers were quite unaware of the existence of any law on the subject, and before people applied for an alteration of the existing law the powers already possessed should be fully exercised. Early official notification to employers from the Registrars or Health Office of confinements amongst their employées was essential to the successful working of the 17th section of the 1891 Act, as it was no part of the employers' duty to make inquiries in this respect. In his opinion the provision of the crêches was *par excellence* the very best means of dealing with the question. The cost should be paid by the parents. He knew that in Stockport women did pay small sums to other women to look after their children while they were at work.

Dr. Musgrave Craven (Kendal) said that most Medical Officers of Health knew very well that a very large number of married women who were employed in factories were nothing more or less than the keepers of their husbands. The remedy was that woman should remain at home and perform the duty of a woman. They should not mind the howl of the capitalist for cheap labour when they had to deal with human life.

Dr. G. Reid (Stafford) replying on the discussion said he never suggested for one moment that crèches should be paid for out of the rates directly; rather that payment for the maintenance of children should be enforced on those parents who could afford it, and who neglected their home responsibilities—in his opinion the majority of them—to repay the Authority for the cost incurred in the maintenance of such establishment. Why should it be a difficult matter to do that? The State undertook the education of children. Why should not the State commence in the first instance and say, "Not only shall we educate the child but we shall protect it from its birth, not by payment, but by legislating so that it shall be insured that the child shall have proper care?" With regard to providing diet tables as suggested by Dr. Holden, he did not think it was the master's business to educate his employees as to how they should bring up and feed their children. That was a matter which could only be arrived at by education, and which could only be effected in a generation by means of elementary education in schools. He rather thought that statistics showed that a large majority of the women who did not go to work did nurse their children. Dr. Sykes objected to crèches being established by authorities, and thought that the production of a certificate by a mother that her child was being properly cared for would meet the case. As a matter of fact when women went to work in the factories they did send their children to be "taken care of" by some other mother, but what happened? That other mother did not take care of them, and simply gave them bread and water, potatoes and Mrs. Winslow's soothing syrup. With regard to the three months' prohibition, his reason for suggesting that was that they could not ask for too much, and by asking for more than three months they would be doing what Miss Kenealey suggested, namely, prohibiting altogether the work of women in factories. As to the suggestion that women should not be allowed to marry at an early age that was certainly interference with the liberty of the subject, and he did not see how any legislation could prevent women marrying when they liked.

On "The Protection of the Health of Female Workers, with special reference to Pregnancy and Wet Nursing," by HUGH RICHARD JONES, M.A., M.D., B.Sc., D.P.H., Honorary Assistant Surgeon, Infirmary for Children.

THE employment of women in industrial occupations has, for a long time past, been considered to react in an injurious manner directly upon the health and strength of their children. This opinion is partly based upon the natural prejudice which exists to such employment, but it is also, unfortunately, partly justified by medical experience. It must be remembered that the great majority of women employed in industrial occupations are between eighteen and thirty years of age—the great child-bearing epoch; so that it may be assumed that if any occupation affects the health of the workers injuriously, the health of many children must also be affected injuriously. The health of pregnant and nursing women does *not* require more careful attention than that of other women. It is of course true that pregnant women are less fitted for arduous work, and that nursing women are less able to withstand much fatigue without injury to themselves owing to the exhausting function of lactation. All women subjected to the same influences are similarly affected, there being only a difference in degree; but so far as the health conditions of employment are concerned, no special precautions are necessary for one class of women more than another.

Injury to the health of female operatives may be classified as due to the following causes:—

1. Injury depending upon dangers inherent to the occupation, *e.g.*, accidents, metallic poisoning in lead works, respiratory disease in cotton factories, &c.

2. Injury depending upon sanitary conditions of home and factory.

3. Injury depending upon too long hours of labour, improper or insufficient food, personal habits, &c.

Into the general question of the influence of these causes upon health I do not enter, and there is no means of estimating the effects, if any, of these different injurious influences on the special health of pregnant and nursing women; but it is possible to show that the health of their offspring is prejudiced thereby.

If the mortality statistics of the Registrar-General be analysed and carefully studied, it is seen that the rate of infant mortality, *i.e.*, the number of deaths of infants per thousand births is considerably higher in urban than in rural districts. The chief causes of the excess in towns are premature birth, diarrhœal diseases, dentition, digestive disorders, tabes mesenterica, atrophy and diseases of the respiratory system. The period when the town rates are most in excess of the rural rates, are not the earliest weeks and months of infancy, but the later months, for reasons which are given later.

	Excess of Urban rate.		Excess of Urban rate.
1st week ...	23 °/o	1st month ...	27 °/o
2nd „ ...	64 °/o	2nd „ ...	121 °/o
3rd „ ...	83 °/o	6th „ ...	273 °/o
4th „ ...	97 °/o		

A. Deaths from premature birth require consideration first. The Registrar-General found them twice as numerous in towns as in the country, and the following statistics from Scotland emphasise this incidence.

SCOTLAND.	Deaths from Premature Birth per 1000 Births.
Insular Rural districts..	4·5
Mainland Rural districts	11·4
Small towns	15·7
Large towns...	16·1
Principal towns	18·4

So that evidently some relation exists between the number of deaths from premature birth and the conditions of life.

1. In seeking to trace this relation, Dr. Farr found, by comparing the causes of death among infants in certain towns, that there was excessive mortality from this cause where the employment of women was general.

In London the rate was 6·1; in Portsmouth, 10·4; in fifteen large towns, 12·4, and in seven textile towns, 13·8. It must be remembered, however, that the number of deaths from premature birth varies greatly in different parts of the country, and may be abnormally high in certain districts (Eastern Counties) where there is little or no employment of women.

2. There has been a steady and continuous increase in recent years of the number of deaths recorded from premature birth.

Premature Birth.

1861—65	11·19	1876—80	13·38
1866—70	11·50	1881—85	14·17
1871—75	12·60	1886—90	16·14

The only feasible explanation which has been offered of this marked increase, is the more general employment of women. It has however been suggested that the increase is in part due to more perfect registration of live births, and in part to the transference of cases from one alleged cause of death to another. These considerations are insufficient to account for the enormous increase. It has also been suggested that a high death-rate from these causes depends upon a high percentage of marriages of minors. The proportion of such marriages has not however varied appreciably, and this explanation may be at once dismissed. We may conclude, with a fair amount of confidence, that the employment of women tends to increase the number of deaths from premature birth.

B. On investigating the other causes of excessive infant mortality in towns where there is general employment of women, it is easier to connect the two as cause and effect. Deaths from premature birth may be considered as due to prenatal influences, deaths from other causes to postnatal influences.

1. In the investigation made by Dr. Farr, previously referred to, it was found that the other causes of high infant mortality in textile towns depended upon neglect of children by their mothers, and therefore the urban mortality is highest toward the end of infancy.

2. More recently Dr. George Reid has investigated the subject with the help of mortality returns from districts in Staffordshire, and found that the rate of infant mortality varied with the proportion of women employed. He found a similar relation to hold good when the statistics for all England were similarly analysed.

3. We know also that while in Belgium the death-rate from 1869 to 1872 was 24·3, by improved sanitation it had fallen in 1885—1888 to 20·25. Yet the rate of infant mortality during the corresponding periods rose from 148 to 159. The only explanation that has been offered is the more general employment of female labour.

The reason for this association of high infant mortality with general employment of women suggests itself at once. The mothers do not nurse their children, but are obliged to entrust them to the care of older children or to complaisant neighbours.

In a few cases they are left in a day nursery. When in times of industrial depression and stagnation, *e.g.*, during the cotton famine in Lancashire, during the siege of Paris, during the recent coal strike, mothers nurse their own infants, then the rate of infant mortality falls. The same fact is proved by a comparison of the statistics of the rates of infant mortality in the different European states. Where the proportion of children artificially reared is high, there also a high rate of infant mortality prevails. A detailed analysis of the registered causes of death affords confirmatory evidence. The excess is attributable to the prevalence of zymotic diseases, respiratory diseases, and to digestive disorders.

Zymotic diseases are more frequent because of the insanitary conditions of the dwelling-houses and the increased risk of exposure to infection. Respiratory diseases are more common owing to want of care, infants being especially susceptible to alterations of temperature. Digestive disorders depend upon improper or insufficient food, and are largely attributable to ignorance. So important is this last factor that it has been estimated, and I do not think that the estimate is in excess of the truth, that more than 50 °/$_{o}$ of the deaths of infants are due to improper feeding.

The close dependence of digestive disorders on artificial feeding may be shown in two ways:

1. The fatality of infantile diarrhœa is well known. Dr. Hope investigated 1000 fatal cases occurring in Liverpool, and found an excessive incidence on infants wholly fed on artificial food, while infants entirely breast-fed enjoyed comparative immunity.

2. I myself have recorded and analysed 1000 consecutive cases of infants brought to the out-patient department of the Liverpool Infirmary for Children, and found that breast-fed children suffered least from digestive disorders, and children wholly reared on artificial food suffered most; while children partially fed on the breast and partially on food suffered in an intermediate degree, the percentages being 38, 56, and 88 for children under three months of age.

We may therefore conclude that the employment of *married* women (or women with children) in industrial occupations is distinctly prejudicial to the child. The percentage of married women so employed varies greatly in different occupations; in some instances more than 50°/$_{o}$ of the women employed are married.

I proceed to consider the reports of the Assistant Lady Commissioners, presented to the Royal Commission on Labour, on the employment of women. Little direct evidence was given on the question we are considering. One or two medical men expressed the opinion that the injurious effects of occupation which I have referred to were not confined to women, but were perceptible in their children, who were unduly delicate and weak. Exact and trustworthy information on this point is still wanting, however.

Much, however, may be learnt from the reports bearing more indirectly on the subject, especially important when we come to consider the best means of dealing with the question.

1. Causes of the employment of married women. Sometimes, we learn that married women go to laundries (for example) when their husbands are out of work, and they themselves had no trade. Sometimes their husbands were in the same trade and required assistance, best given by those who had an interest at stake. Sometimes they were employed because there was actual competition with male labour. One reason deserving of careful consideration was given. After marriage the women miss not only the cheerful society of the factory but also the steady work to which they have been accustomed, and for both reasons they persist in going to the factory. It was stated that factory girls make wretched housekeepers, spoiling food by bad cooking and not knowing how to keep the place tidy. In Birmingham it was said that a comfortable home is an exception.

All classes agree in the undesirable effect on the home of the absence of the mother, but there was no agreement as to the desirability of prohibiting by law the employment of married women. It was suggested that it might lead to concealment of marriage, but this would only be temporary. Some employers insist on girls leaving a few months after marriage, and no married woman with children is engaged by them until the matron, by personal visiting, has ascertained that the children can be looked after by relatives in the mother's absence. It was stated that in works where no married women are employed more single women over twenty-five years of age are found. They do not marry so early, and are less likely to be married by men in search of a wife to support them.

2. Influence of factory life. Besides the inaptitude for household work, a low standard of morality was found in some cases. This was wholly attributed to defective sanitary conveniences, and found associated with a low standard of wages.

We may therefore conclude that the employment of women in industrial occupations—

1. Before marriage or during pregnancy, leads to excessive infant mortality from premature birth. Probably also many of the children who survive are weakly and delicate.

2. After marriage, leads to excessive infantile mortality from

causes depending upon the necessary abrogation of maternal duties, by the mother's enforced absence from home.

It is therefore desirable, in my opinion, that pregnant or nursing women should not be employed in industrial occupation. Probably the prohibition of employment for three months before confinement, and for six months afterwards, would theoretically prevent most of the ill effects we have been considering; but this prohibition would be difficult to enforce, and a rigid rule of this kind would probably occasion much hardship.

It is a matter of regret that any necessity for the employment of married women exists, but in our present social circumstances it is difficult to see how it can be wholly avoided. All that can be done immediately is to neutralise, as far as may be, the injurious consequences which result.

Gratifying results followed the establishment of a maternity fund at the factory of M. Dolfus, a cotton manufacturer of Mülhouse, to which the married women paid contributions, which were supplemented by M. Dolfus. By this means the women were enabled to remain longer away from work, and the mortality of their infants was diminished one-half. Such a scheme is, however, utterly inadequate. Charwomen and others not employed in large factories would not be provided for. A scheme of universal insurance is impracticable, and the prescription of forethought and prudence futile.

I can only suggest the general establishment by the local authorities of numerous crèches, where the babies and children can be conveniently left (on the payment of a moderate fee) and carefully tended. This plan has been strongly recommended but has not been attempted on a sufficiently large scale as yet.

Second—if second—in importance to the neglect of maternal duties, is the profound ignorance which prevails concerning the care, feeding and management of infants and children, and of the elements of domestic economy and household management. The highest standard in our Board Schools might well include sound practical instruction in these matters. Much progress is being made in this direction. The development of technical instruction, and the personal house to house visitation by well trained, well educated lady teachers, as in Buckinghamshire, may be mentioned.

But after all, the real cause of the excessive infantile mortality—attributed in this paper in some measure to the employment of women in industrial occupations—is more deeply seated in our social system, and can only be successfully combated by greater knowledge—the diffusion of knowledge among the wage earning classes, and by the development of a deeper sense of personal responsibility.

On "*The Position of the Study of Industrial Diseases. Its past Neglect and its Scope,*" *by* J. T. Arlidge, M.D.Lond., F.R.C.P.Lond.; Consulting Physician to the North Staffordshire Infirmary, Stoke-on-Trent.

(Member.)

By industrial diseases I mean all departures from health attributable to occupation. These disorders have received but slight attention in this kingdom, and in consequence the literature of the subject is meagre.

The sources of disease generally have been assiduously followed up, excepting those found in occupation. This seems the more strange inasmuch as they are of every day observation and available to inquiry, particularly so in this preeminently manufacturing country.

Pathologists have described a host of lesions and speculated on their causes, but in many instances they have failed to note the connection between them and the circumstances of labour, and have failed to differentiate between the product of general pathological conditions and that of special conditions connected with employment.

This statement may be illustrated by the loose way in which such terms as phthisis, consumption, chronic bronchitis, asthma, and pulmonary fibrosis are made use of in returns of the causes of death among persons busied in various trades. The words consumption and chronic bronchitis conceal a vast mass of ignorance respecting the actual conditions causing death, and an equal amount of inertia in the investigation of pathological phenomena.

Recently industrial diseases have been largely brought to the front, in consequence mainly of inquiries instituted by Government into the causes of the heavy mortality and sickness found to prevail among the workpeople employed in many of the leading manufactures. The results have been published in the shape of "blue books," whose principal feature is rather that of bulk than that of literary excellence and agreeable reading.

Moreover, like other novel movements, the subject has been ardently taken up by the "Press," and especially by certain periodicals which address themselves particularly to working men. In the columns of these papers the subject has been discussed too often from one point of view, and upon imperfect observation and apprehension of facts. Whence it has happened that the descriptive accounts of methods of manufacture and their influence upon health have been marked by inaccuracies and exaggeration.

The aim on the part of some writers appears to have been to engage public attention by vigorous and sensational articles, rather than to convey what were the actual results of investigation and the lessons to be learned therefrom. Indeed, even in the Reports of the Government Commissions much irrelevant matter and many ambiguous statements find place, the outcome of trade prejudices and of popular notions—the fruit of uneducated observation.

In short, in connection with the whole subject as between masters and men, statements and counter-statements have been alike exaggerated; and, therefore, the conceptions formed by the public of many manufacturing processes have been more or less erroneous.

Sensational and sentimental members of the community have been greatly shocked by the revelations served out to them, and have been led to view with some measure of horror all manufacturing operations which involve exposure to dust, heat, smoke, or strong physical effort; or which subject the operatives to evil smells, to uncomfortable attitudes, or to many other incidents of labour foreign to a comfortable sitting-room, and the amenities of life theoretically belonging to everybody.

Nevertheless, although the evidence collected concerning manufacturing occupations and their effects on health prove a state of things far from satisfactory, and excluding the exaggerated statements tacked on to it, no question can be entertained that it points to great neglect of sanitary precautions up to the present day, on the part both of employer and employed; and that it becomes the duty both of public authorities and private individuals to promote and extend sanitary reforms without loss of time. It also serves to indicate in what direction and by what means the recognised evils may be averted, or vastly reduced both in number and in energy, and demonstrates that to ensure reform there must be concurrent action between masters and their workmen.

It is in vain to provide sanitary arrangements and healthy surroundings if the workers will not rightly use them, or render them nugatory by carelessness and indifference. Nor will the best sanitary arrangements within the factory avail materially to improve health and stave off disease, if the healthiness of the home be unconsidered, if cleanliness in person and work be disregarded, and if habits of dissipation and intemperance be persevered in.

On the other hand, notwithstanding that owners and occupiers of factories have, in many instances, given anxious thought to the healthfulness and general well-being of those they employ; the improvement in the sanitation of factories and workshops has not kept pace with that in the perfection of machinery and modes of working devised to accelerate and cheapen production. And though it may be received as an axiom that the interests of masters are best served by the employment of healthy workpeople, it nevertheless is one that has frequently failed to influence practice.

What is essential to both parties is, that they shall be imbued with the teachings of sanitary science. Employers are called upon to possess a definite knowledge of what is insanitary about the occupation they are engaged in, and of what can be done to remedy evils attaching to it. In like manner the operatives in any occupation should acquire similar knowledge concerning it, and lend willing aid to make efficient whatever measures sanitary science may recommend, and what the laws of hygiene prove necessary.

To impart education of this kind is the purpose of The Sanitary Institute, and happily it is one that has been kept steadily in view. At the same time it must be owned that the work to be accomplished surpasses in extent the powers of any single society. All public bodies have in different degrees the same object to aim at, but this Institute may claim the initiative in advancing it, and also in developing the organization necessary to success. It calls for the services of a band of missionaries to go forth through the length and breadth of the land, and proclaim everywhere the saving doctrines of sanitary and hygienic science.

I may proceed a step farther and say, that sanitary instruction must be supplemented by more or less teaching of building and engineering. For the carrying out of requisite sanitary improvements, the special knowledge and skill of engineers and architects are mostly necessary. What is wanted to remove sanitary defects may be perfectly recognised by the sanitarian, but how to effect the improvement is a question probably beyond his solution. This assistance is especially required where the object is to obtain efficient ventilation, to provide for the heating of shops, to devise means for removing dust and vapours, or to protect the workpeople from the dangers of machinery. And it may safely and without offence be affirmed that of such professional gentlemen those best trained in sanitation will prove the most able to fulfil the purposes referred to.

The whole kingdom is at this time fully aroused to the necessity for the adoption of legislative measures to remedy the well attested evils of manufacturing processes, and to rescue workmen from sickness and premature death. The present Home Secretary has shown the greatest alacrity to introduce such measures, and likewise to gain the fullest information respecting the causes of illness, especially in the class of occupations he has, in his official position, classified as dangerous to health and life. But his efforts must be followed up by a movement all along the line, which shall demonstrate not only what are the sources of industrial disease, but also what are its remedies.

The remarks I have made may seem to be so many self-evident propositions. Granting this to be the case, their recapitulation will not be without some benefit; for general truths, in all departments of knowledge, require, ever and anon, to be kept before us by repetition, and I feel myself absolved from blame to this extent, that, if only common-place facts have been set before my hearers, I have attracted some attention to the study of "Industrial Diseases."

On "The Spread of Typhoid Fever by Sewers," by Professor A. Roche, Dublin.

(Fellow.)

I wish to bring under the notice of this Congress a subject in which I have taken much interest for some years and written upon on more than one occasion; the danger of the spread of Typhoid Fever by the discharge into the sewers of the dejecta in an insufficiently disinfected condition. It is generally admitted at the present time that, whether we accept or not Eberth's bacillus, the chief contagium of Typhoid resides in the alvine discharges. The bacillus has been shown experimentally to have a considerable power of resistance to disinfectants, to live and multiply in sewage, when as in towns in the common sewers they find congenial conditions—darkness, certain amount of heat, and organic matter. I find on investigation that in some of the Dublin Hospitals no disinfectant is used to render the discharges sterile, in others, the disinfectant in use is one not to be relied upon or is used in too small quantity or for too short a time. The discharges then specifically infect the sewage and wherever it goes it carries the fever with it. We are gradually coming to recognise that the real danger in contaminated water is not the mere presence of organic matter but the existence of specific pathogenic organisms. To prevent the entry into sewage of these organisms ought to be the aim of the hygienist as it is through sewage the water is generally infected. The safest and surest way of disposing of Typhoid discharges and all specifically infected ones is undoubtedly to destroy them by heat. I consider that all Hospitals and Public Institutions should be obliged to deal with the discharges in this way. I understand that the Hospital at Leicester has already a destructor for this purpose and the authorities of the Meath Hospital, Dublin, have decided upon having one. The cost is merely trivial, as I am informed it can be erected for £100. Dealing with the discharges in private cases is far more difficult. Nurses ought to be instructed upon the absolute necessity of using an efficient disinfectant, in sufficient quantities, and for a sufficient time, before throwing the discharges into the drain. It might be possible in the future for the Public Health Authorities in each town to supply specially constructed receptacles for such discharges, to collect them daily and to destroy their contents in a destructor.

Dr. G. W. **Steeves** (Liverpool) asked whether it had been the experience of the writer of the paper that this plan had yet been adopted in any part of the country. The idea had already occurred to him to make a systematic and careful collection of the dejecta in cases of typhoid in a given district, and having the dejecta destroyed by fire; that was to say, cremated. He had already brought the matter before his own Board.

Dr. **Peck** (Ormskirk) pointed out that Professor Roche in his paper gave an instance; also Dr. Sergeant had designed a destructor at Bolton, which has been in use for some years for the destruction of typhoid stools.

Sir **Charles Cameron** (Dublin) said that about a year ago he addressed a circular letter to the Hospital Boards in Dublin, suggesting the destruction of typhoid and other objectionable matter by means of a destructor, or by means of such an apparatus as the Washington Lyon's super-heated steam steriliser. At the present moment one Dublin Hospital had ordered a destructor. Unfortunately the destructors that had hitherto been made were upon too large a scale; what was wanted at the present time was a moderate sized destructor. The Dublin Hospitals had accepted the principle of destroying typhoid dejecta and other objectionable matter, and he hoped some of the mechanical engineers would devote their attention to providing an apparatus well constructed and smaller. With regard to the general spread of typhoid fever by means of sewers, he thought that the evidence that the disease was spread in that way was of the very feeblest character. Whenever a case of typhoid fever occurred, either the water was blamed, or the milk, or the sewers, or the house drains, but the precise evidence as to the spread of the disease by any one of those channels was in most cases very limited. The water supply of Dublin was unrivalled for purity; the main sewers and house drains were as good as any other place, with the exception, perhaps, of London and one or two other towns, and yet with the exception of Belfast, they had the highest typhoid death-rate in the United Kingdom. There was a growing tendency to the development of the disease in Dublin, and therefore the phenomena of it could not be explained by the water being impure, or from defects of the house drains or sewers. If all they heard about the *materies morbi* of typhoid fever be true, it was not likely that the organisms that produced the disease could be disengaged from sewage, and therefore he did not think that the disease was propagated to any important extent by means of defective sewers. In fact, they have heard such roseate accounts lately of sewers, as to lead one to think that the purest air they could get anywhere was the air of the sewers, which might be looked upon as a kind of Health Resort.

Mr. Rickaby (Sunderland) said he came hoping to receive considerable enlightenment with regard to the contributing causes of typhoid fever, but he had not received very much light except what had fallen from Sir Charles Cameron. In Sunderland they had water as pure as could be found and a fairly satisfactory system of sewerage, and yet typhoid fever was the only infectious disease which came to them in an epidemic form.

Dr. R. S. Marsden (Birkenhead) said that the great difficulty which they as Health Administrators had to meet, was the entrance into the sewers of the discharges from typhoid patients in the houses of the poorer classes where they had no nurses and no real instruction to enable them to judge as to the suitability or otherwise of passing such excreta into the sewers. With regard to the cremation of such excreta infinite difficulties arose when they came to put it into force. There would have to be a regular daily or bi-daily collection from typhoid houses, the expense would be large, and they could not always insure that the people would avail themselves of the pans prepared for them. If they could imagine an ideal community in which the lower classes were so educated as to avail themselves of the means at their disposal he could quite agree that the plan of cremating the excreta was most desirable. He could not agree with Sir Charles Cameron that they were rarely able to trace the spread of typhoid fever from sewer gas. It was his experience and that of other Medical Officers of Health that in a very large proportion of cases when the drains of a house in which typhoid had broken out were examined, there was ample defect in the drainage system to fully account for the infection getting to that house. The danger is in the *drains* of the house rather than in the sewers. In the sewers where there is plenty of water always flowing, the danger may be slight, but in the drains where there is ample facility for the drying of the surface and frequently imperfect cleansing, once let typhoid motions get passed into them, and the air currents leaking from every defective joint into the house must carry with them the typhoid poison.

Mr. **Washington Lyon** (London) considered that in every ward in an infectious hospital there ought to be a simple apparatus to destroy the germs as fast as they were produced.

Dr. J. **Brown** (Bacup) said that Sir Charles Cameron's remarks confirmed his own experience as Medical Officer of Health of an urban district for seventeen years. He should say that 70 per cent. of the cases could be clearly traced either to water or milk contamination.

Dr. H. E. **Armstrong** (Newcastle) said that typhoid fever in Newcastle was becoming year by year less frequent, and that was a consummation most devoutly to be wished, for all concerned. Newcastle was built on a clay soil, and that, he believed, had a great deal to do in its immunity from typhoid. Sewers were perhaps a little too freely blamed for a great deal for which they are not responsible. As Medical Officers of Health they had all to do with defective drains, and it was their business to have them put right, but it was not their business because they failed to find a satisfactory and clear reason, to begin to blame the drains at once. They were able to remedy a great deal on the surface that the drain was not to be blamed for. He believed himself that typhoid fever in some towns was to be accounted for distinctly as a sort of malarial disease. The immunity in Newcastle probably depended largely upon the clay formation of the soil.

Mr. J. **Brand** (Wigtownshire) explained the system to be adopted in connection with a small hospital about to be erected in his district and in the vicinity of the Burgh of Newton-Stewart, for disinfecting the sewage from the hospital, before allowing it to be discharged into the main sewer of the Burgh. The arrangement consists of a cesspool having two compartments, each capable of holding twelve hours' discharge. The entrance and exit to each cesspool are by sluice valves, so that the compartments can be used alternately, one being filled can have the valves closed and the contents properly disinfected, and if need be, otherwise purified, before the final discharge into the town sewer. In the meantime the sewage from the hospital will be discharged into the other compartment, which in its turn will be closed and disinfected in the same way. The advantage of this alternative cesspool lies in its perfect simplicity, in the certainty that it cannot be discharged by accident, and in the relatively small size which will necessitate a constant, daily and therefore reliable routine attention.

Dr. J. F. J. **Sykes** (St. Pancras) said the point of the paper, he took it, was the destruction of typhoid excreta in hospitals, and had nothing to do with the treatment of sewage generally; they might prove up to the hilt that the air of sewers was comparatively pure and that the chemist could not find typhoid organisms in a sewer, but an enquiry he made some years ago at a large institution in London where there was an outbreak of typhoid fever convinced him that the disease could be spread by sewer gas. Dr. Sykes described the system of drainage at the institution and showed by means of diagrams how he discovered that typhoid excreta found its way into a warm grease trap, the vapour from which ascended to the kitchen. The disease fell heaviest upon those who worked in the kitchen, and together with the other facts there was clear proof that the typhoid was spread through infected vapours. That being so he could not accept the argument that typhoid could not be spread by sewers.

Sir **Thomas Crawford** (London) said he was strongly of opinion that it was essential for sanitarians of every class to see that no emanations from sewers found their way into the atmosphere of dwelling-houses. With regard to the spread of typhoid fever by sewers, he stated that for several years he was at the head of the Medical Department in India. The troops were stationed in various parts of the country in cantonments, especially built for their accommodation. The dry system of conservancy was used; there were practically no water-closets except in the larger towns; all the excreta were mixed with earth, and afterwards buried, and yet they had a larger proportion of enteric fever amongst the young troops in India than would be found in any town in England. They must not be satisfied with following the typhoid bacillus from the water-closet. He was not prepared to advance any theory as to how this fever was spread, but unless they got thoroughly at the bottom of that point, they would make very little progress in freeing the people from one of the most fatal diseases to which they were now subjected. He thought that Sir Charles Cameron was quite right in reminding them that they must not depend altogether upon sewers in explaining the origin and the propagation of enteric fever.

Dr. **Stoney** said that his experience of twenty years bore out what Dr. Marsden had said.

Dr. **Williams** (Flint) said that in recent years there had been a good many typhoid cases in Flint, and in each report he had made on the outbreak his conclusion was that he had not been able to find the source of the disease. The only explanation to his mind was that the germs lay dormant for some months, that some circumstances favourable to their development occurred, and then that practically they must come into the system by means of the air we breathed. He complained that nothing had been done by the Congress to help Medical Officers of small towns, who oftentimes had to deal with problems which were more difficult than those which arose in large towns.

Dr. Willoughby (Eastbourne) remarked that, whether sewers spread typhoid or not, it would be keeping on the safe side and be a great advantage to keep the infectious dejecta out of the sewers. The practical point arising out of the discussion should be this, that the infectious dejecta from hospitals at any rate should in every case be destroyed and not admitted to the sewers, and in towns as far as possible it should be either collected and destroyed or its thorough disinfection seen to, by inspectors.

Sir Charles Cameron (Dublin) said he wished to explain that he attached the highest degree of importance to the necessity for sewers and house drains being kept in good order. House drains and even many sewers leaked an enormous quantity of most objectionable matter into the ground, and it was his theory that the soils themselves were to a great extent the source of contagion of the disease. He believed that leaking sewers were most dangerous to the public health.

Dr. Herbert Jones (Crewe) said that whether typhoid was spread by sewers or not there was no doubt that it was spread through the dejecta which ought certainly to be kept out of the sewers. In Crewe a sanitary pail and disinfectant were supplied to every typhoid patient's house. The contents of the pail were taken to the sewage farm and there disinfected and buried. If they had the means of burning the matter no doubt it would be better, but all towns were not able to afford a destructor.

Dr. Holden (Mayor of Preston) said he had often wondered what the real cause of typhoid was, and he was inclined to believe that the suggestion thrown out by the Medical Officer for Newcastle had probably the germ of a great truth within it, namely, that typhoid was more or less malarial.

Dr. O'Flaherty pointed out that if typhoid was spread from the ground malariously, as Dr. Armstrong would say, it was merely because it had leaked out from the receptacle which took in the human dejecta. In Liverpool, for instance, in the poorer neighbourhoods, he thought that the disease was spread from the dust from dirty clothing which was brought into the air.

Dr. Watson said it had been his lot to live in the interior of China for the last ten years in charge of a hospital there. Every class of disease was there except typhoid fever. He had never seen a case of typhoid, though they had epidemics of cholera, and had malaria with them during the greater part of the year. The habits of the people violated every law of health, and there was no system of drainage whatever. The Chinese, however, always boiled the water, and drank it while it was hot. Moreover, no milk was used by the people there. These were the conditions existing in a district in which there was no typhoid. The water was well water, and he was perfectly certain it was contaminated. At the same time he never saw disease spring from the drinking of water, and he attributed that to the fact that people avoided cold water, and invariably drank it after it had been boiled, and while it was hot.

Dr. **Sykes**: Is there any diarrhœa or cholera?

Dr. **Watson**: Yes, most severe epidemics such as would set this country wild, and which are never reported. Not every year but in a succession of three years.

Dr. **Austen Williams** (Liverpool) said that Dr. Watson's remarks bore out what he himself had heard from a medical man who had been in China. One word as to the difficulty of tracing the origin of typhoid fever. It was difficult for Medical Officers of Health and more so for general practitioners. Frequently they had only one case in a house where all the family were exposed to the same influences. Again, it often happened that a person returning to town from his holiday in some country district developed typhoid, and the only association could be traced with any contaminating influence was drinking water from some stream or brook, yet the people in the district could drink the water with impunity, but Liverpool gentlemen seemed to be more susceptible. The question arises are some susceptible and others not, and is it possible to cultivate a refinement of the system that makes it have less power to resist infection?

Dr. J. **Clare** (Hanley) said his experience was different from that of Dr. Armstrong, for though Hanley and other neighbouring towns in the Potteries were on clay soils, they had been by no means free from outbreaks of typhoid.

Dr. **Peck** (Ormskirk) said that typhoid and cholera were usually regarded as being principally water borne diseases. Could Dr. Watson give any reason why there should be freedom from typhoid fever while cholera was very common?

Dr. **Watson** replied that from his experience it did not require water to carry cholera. Other agencies were at work, as was evident from the way cholera spread along trade routes.

"*On Pawnbroking Establishments as a Source of the Spread of Disease*," by PROFESSOR A. ROCHE, Dublin.

(FELLOW.)

THERE is no more important duty of the Medical Officer of Health than to investigate all the probable sources of the diffusion of diseases especially infectious. I can find little reference to a possible source I desire to bring under your notice in this paper. The poor when struck down by illness have rarely any savings to fall back upon and are obliged to pawn their goods in order to obtain the necessary food and medicine. The first objects that present themselves are often the very clothes of the sick man, in case of infectious diseases saturated, I may say, with infection. When the clothes are not selected still some soft goods, as being more portable, and frequently from the room where the sick person is living, are sent. The clothes or soft goods when accepted, and I do not find pawnbrokers make any inquiry as to the possible existence of infectious disease, are rolled up and placed on shelves in a room frequently containing hundreds of such bundles. This exposes other clothes to infection, and when redeemed tends to the wide diffusion of the disease. The evil does not end here. Should the goods not be redeemed they are at the end of a year sold by public auction. Most of these goods are then purchased by second-hand clothes merchants and eventually find their way into second-hand clothes shops there to still further spread the disease. It has been shown again and again that infected clothes retain under ordinary circumstances their infection for an almost indefinite period. Sir Thomas Watson's celebrated case where a small piece of flannel retained the infection of scarlatina more than a year and gave the disease to a child who put it round her neck for a minute will be in the recollection of those who have read his fascinating lectures. Not alone the so-called infectious diseases but also diseases not generally recognised by the public as infectious may be spread in this manner. When we recollect the thousands of the poor who are sufferers from tuberculosis, the want produced by the sickness, the necessity and ease of obtaining a little money on their clothes, their want of cleanliness and the too frequent prospect of their sputa being expectorated and dried upon their garments, I do not think it will seem unreasonable to suggest that consumption has been spread in this way. How to meet this evil and to lessen or prevent the spread of disease by pawnbrokers I will now shortly touch upon. It seems to me useless to simply deal with it by making it penal to pawn infected articles. The pledgers will evade this by giving a false address. We must take some measures to treat the articles when in the possession of the broker. I would oblige pawnbrokers to send each day the soft goods received that day to the Public Disinfector, or the Sanitary Authorities might send for them and return them to the offices when disinfected. By this means we would be assured that what have been called the banks of the poor, are not also centres for the diffusion of disease.

On "The Theory and Practice of Disinfection by Heat," by WOLF DEFRIES, B.A., M.I.Mech.E.

ABSTRACT.

HEAT disinfection is specially important because of the relative uncertainty of other means. The efficiency of chemical disinfection depends usually on its methods of application, which are sometimes extremely difficult even for practised experimenters, and practically no chemical process is applicable equally to all contagia. The process in particular most common in this country, the use of burning sulphur or of sulphurous acid otherwise provided, has been demonstrated over and over again from the experiments of Koch and his colleagues in 1881 down to those of Dr. Trétrop in Antwerp last month, to be inefficient even in a laboratory, and hopelessly unreliable in actual use. Dr. Sternberg characterizes its application as "a mere farce," and the International Congress in Vienna in 1887 and every subsequent Hygienic Congress to which it has been submitted have unreservedly condemned it.

The test of true disinfection has been stated by Sir George Buchanan and Dr. Parsons as the destruction of the most stable known infective matter. It is of importance to require apparatus to satisfy this test, not only for the moral effect of certainty in such matters, but because of the possibility of less advantageous conditions, tending to reduce temperature, occurring more readily in practice than in trials, particularly with apparatus in which accurate knowledge of temperatures is not possible. It must further be remembered that bacteriology has not yet isolated all the contagia even of the commoner diseases, and conceivably may disclose others which also attain the maximum resistance of those already known.

The temperature of true disinfection varies according to the medium by which the heat is conveyed. In water a temperature of 212° F. is not fatal, even after many hours, to all contagia —for instance, the dried spores of tuberculosis, such as may be found on dry blood spots, expectorations, &c. It is therefore of the utmost importance that every part of the object to be disinfected should be subjected to at least 212° F., which is not necessarily easy to obtain in bulky masses of non-conducting material such as, for instance, sheets. The boiling-pan, used by the Paris hospitals for disinfection of moist expectoration, &c., of consumptive patients, provides for this difficulty by causing any water in the pan which may fall below the desired temperature to be ejected into a lower pan, where it is re-heated. On re-attaining its proper temperature, it again rises into the upper chamber. The temperature is sometimes set higher than 212° F. by using a solution of higher boiling-point, such as carbonate of potash or soda.

The same process has been extended to the provision of water, either for drinking purposes or for use where absolute sterilisation is required—as, for instance, in operating theatres. For this purpose the water passes through a vessel of definite volume at a constant pressure and is heated by a steam coil of definite pressure and consequently definite temperature (usually 120° C.). The condensation of the steam at such times as the water is below the desired temperature of sterilisation is arranged to impart the required heat to the water, and to close the inlet valve and accordingly stop the flow until such temperature is attained. The volume, pressure, and outlet of the sterilising vessel determine the rate at which it empties itself, and, therefore, the net time of actual flow during which it must remain in the sterilising vessel; and as the flow is only possible while the pre-determined temperature of sterilisation exists, the apparatus provides a purely thermal and automatic guarantee that the out-flowing water has for a definite minimum time been at that temperature. The practical application of these devices is, of course, limited, but they are valuable as types of automatic control over disinfecting processes effected by simple means.

Heat for disinfectant purposes can be otherwise obtained to a greater or less extent by hot air, dry or wet, by steam currents, or by steam confined under pressure. The use of hot air, either dry or wet, has been shown to be absolutely ineffective. Koch and other later investigators found that it could not disinfect naked organisms except at temperatures (280° to 300° F.) above those which any ordinary material, except horsehair, could endure, and that its penetration into objects such as mattresses was practically impossible. The effect of steam in disinfection is entirely different according as it is superheated or saturated. These terms are used in the sense that at a given pressure, steam is saturated when it is of the temperature at which under that pressure it can condense, or at which water under the same pressure can become steam, and superheated when it is of a higher temperature. At the ordinary atmospheric pressure, for instance, steam is saturated at 212° F. The temperature of true disinfection for superheated steam (Esmarch, &c.) is about the same as for hot air. For saturated steam it is 234° to 239° F., as determined by independent Commissions of the French Government, and the Hospitals of Lyons and Copenhagen, and other experimenters. The temperature of disinfection, as agreed at the Venice International Congress of 1892, must be attained in every part of the object to be disinfected, and the Buda Pesth Congress has in the last few weeks resolved that no apparatus ought to be used in which the temperature in any part of the object was more than 1° C. below that in the stove itself. This stipulation secures a reliable inference from the temperature of the stove to that of the object, and also protects the object from being subjected on its outside to temperature which would injure it.

Steam currents at 212° F., though permitting a lighter structure and greater simplicity, do not give true disinfection. They have also the disadvantage of requiring a relatively long exposure and an expense of steam, and therefore of fuel, considerably greater than is required in the use during the same time of steam confined under pressure. The objects treated by them are, if thick, difficult to dry, and their efficiency varies with the velocity of the steam. Similar objections apply to currents under slight pressure.

Confined steam is in some stoves superheated by means of a steam-jacket at higher pressure, or some other device for providing a large surface at higher temperature than the steam, and in contact with it. The superheating is intended to assist the drying of thick objects, such as mattresses. Esmarch subjected rolls of blankets to superheated steam, and found that organisms which were killed in the centre by one and a half to four minutes exposure to 212° F., survived on the outside exposures up to forty minutes to temperatures varying between 212° F. and 221° F. to 285° F.; the reason being (as the dampness of the inside of the roll showed), that the steam in the centre had been cooled down to a saturated condition, while that on the outside, which was dry, had remained superheated. In penetrating a porous object saturated steam condenses into $\frac{1}{6600}$th of its bulk, imparting its latent heat (which would raise by about 27° F. a mass of wool 100 times its own weight) to the object, and sucking into the vacuum so formed fresh steam to repeat the operation, until the whole mass is of the temperature of the steam. Its pores then contain a fine film of condensed steam, still under the pressure at which its temperature enables it to boil; and when steam is let off, the whole of the vapour, into which by the reduction of pressure this film is converted, expands suddenly and strongly, and can by suitable means be swept out of the stove, leaving the thickest object perfectly dry. In the case of superheated steam as used in practice, the contact with the cold object cools the steam below its saturation point, and the process goes on as with saturated steam, until the difference in temperatures between the object and the steam becomes insufficient to reduce the steam to its saturation point. From this stage, which is reached much earlier on the outside than in the inside of an object, the further heating proceeds, as with hot air, by the much slower process of conduction, and the disinfection falls in power to that due to superheated steam. The practical difference as to rapidity appears from Dr. Parsons' report and those of the French and Danish Commissions to be that complete penetration can be obtained within about 2° to 3° C. in fifteen to seventeen minutes with saturated steam at 10 lbs. pressure, and within 6° to 11° F. in thirty minutes by superheated steam at 20 lbs. pressure. Since the date of the former experiments it appears that the temperature with saturated steam can penetrate into a large mattress in fifteen to seventeen minutes to within 1° C. of that of the outside steam. These results as to saturated steam have been verified by numerous experimenters, and it has been shown in each case that true disinfection is reliably obtained in that time in all parts of the object. True disinfection is also obtained in the interior of a similar object by the use of superheated steam at the higher pressure and temperature for the longer period; but the extent, if any, to which disinfection occurs on the exterior does not seem to have been ascertained. The absence of necessity to assist drying by superheating is shown by the experiments of the French Commissions, which found that in a suitably arranged stove, light objects actually lost moisture in the disinfection, and heavy mattresses were dried in fifteen to twenty minutes to a gain of only ½ to 1 per cent. of their original bulk, an amount of variation which is considerably exceeded in ordinary use through variations of atmospheric humidity. This time has been still further reduced by subsequent modifications of construction.

Saturated steam stoves are also made with very slight pressure, working to a temperature only slightly above 212° F. The longer exposure and the difficulty of drying thick objects, render them usually disadvantageous, apart from the fact that their temperature is too low to effect true disinfection. The object of their use is a saving of first cost by using a construction lighter in proportion to the lowness of the pressure. So soon, however, as any pressure is admitted into an extremely large object, a certain minimum of strength is in all cases desirable; and it is doubtful whether in a well made stove the saving in first cost would warrant any substantial sacrifice either in convenience or efficiency.

In general, it appears that the temperatures ordinarily used in steam stoves do no substantial injury to the objects exposed to them. There are, however, no satisfactory comparative results on the subject. Experiments in progress by the author were not sufficiently advanced to make them worth communicating.

It is desirable that the standard of true heat disinfection should be definitely raised to that which, on present knowledge, is the temperature of true disinfection. As voted by the International Congress in 1892, at Venice, and in this year at Paris, no apparatus should be considered efficient which does not produce such temperature; and, in the sense of the resolution of the Buda Pesth Congress, the temperature should be, within the limit of a degree or two, equal to that of the steam by which alone it can in practice be produced. So far as practicable every process of the operation should be automatically controlled, indicated, and, as resolved at Buda Pesth, recorded for supervision and reference.

[*For discussion on this paper see page* 533.]

On "Disinfection," by W. Daley, Chief Sanitary Inspector, Bootle.

ABSTRACT.

Precautions to be taken by disinfecting attendants after handling infected clothing, &c.

1. Before entering an infected room a glazed mackintosh must be put on and kept on until leaving the room. It is then to be taken away in the tin box provided.

2. After leaving an infected room, any member of the staff must return to the Town Hall Yard; trams, public vehicles, shops, the Inspector of Nuisances Office, or any other part of the Town Hall building must not be entered until the following precautions have been taken:—

3. He must first be fumigated in the apparatus in the Town Hall Yard. He is then to proceed directly to the bathroom, undress, and place the clothing taken off in a box, and close the box at once.

4. A bath must then be taken and disinfected clothing put on.

5. The clothing in the tin box, and the mackintosh are to be stoved for four hours.

6. The above precautions also apply when any fever case is taken to Hospital, or when an Inspector for any purpose whatever enters an infected room.

7. The person using the bath to make an entry in the book provided, stating the time of using, the address of the infected house, and the nature of the disease.

The fumigating chamber is a wooden box 6 feet high and wide enough to allow a person to stand in it. A fan is used to exhaust fumes when this is deemed necessary.

The apparatus is so constructed that a person can fumigate himself unaided.

It can be easily taken from one place to another by one man, the machine being on wheels.

[*This discussion applies to the papers by* W. DEFRIES *and* W. DALEY.]

Councillor COMPSTON (Chairman, Health Department, Rawtenstall) asked Mr. Daley What of the infection still remaining in the beard and whiskers, which, notwithstanding all the ingenuity of his apparatus, escaped fumigation altogether, and might infect the first susceptible person he spoke with?

Dr. E. SERGEANT (Medical Officer of Health, Lancashire County Council), said that an apparatus like that suggested by Mr. Daley would be very useful in workhouses for tramps who went about covered with all kinds of filth.

Dr. J. F. J. SYKES (St. Pancras) said he wanted to know whether there were any experiments upon a large and practical scale to show that fumigating by gases had ever been successful. He thought it was without contradiction that fumigation by gases was not complete.

Sir **Chas. Cameron** (Dublin) remarked that a great many years ago—early in the present century—he made some experiments with regard to the value of gaseous disinfection, and published the results in the appendix to a book of his on Hygiene. He came to the conclusion that besides disinfecting rooms in the usual way with sulphur dioxide, it was necessary to have the gas mingled with steam, to cleanse the rooms most thoroughly.

Dr. F. **Vacher** (Birkenhead) said that the result of experiments his opinion and advice had been in favour of putting some moisture into the air along with the disengaged gas.

Dr. H. E. **Armstrong** (Newcastle-on-Tyne) said he did not know whether the Medical Officer of Bootle would confirm Mr. Daley's proposal, but if he (Dr. Armstrong) were asked to do so, he would say it was not practicable to carry that kind of thing into effect.

Dr. **Spottiswoode Cameron** (Leeds) was by no means prepared to say that burning sulphur was useless. Probably a process both of reduction and oxidation of organic material took place in a moist atmosphere; H_2S was certainly formed, as anyone could ascertain by smelling woollen articles so treated. That meant that the water molecule was decomposed and that probably nascent oxygen was freed. Alongside of this a reducing process possibly took place with the formation of H_2SO_3 and perhaps small amounts of H_2SO_4. The organic material in which the poison lived was therefore disintegrated. This was not a germicide action but it tended to starve the germ. There seemed no reason to suppose that sulphur di-oxide had any germicide power whatever. It was not therefore to be trusted to for the disinfection of textile fabrics. Sanitary authorities ought to possess efficient steam apparatus for this purpose.

Mr. **Daley** remarked that he wished it to be clearly understood that the machine he had described was never used when clothing could be disinfected in the ordinary way.

On "*The Teaching of Hygiene in Elementary Schools*," by Sir DOUGLAS GALTON, K.C.B., D.C.L., LL.D., F.R.S.

(FELLOW.)

1. What is meant by Instruction in Hygiene?
2. In what way can such instruction be usefully given to children of the class attending Elementary Schools?

1st. The Laws of Health comprise a knowledge of physiology, including the structure of the human body, as well as the conditions which foster development or introduce derangement tending to injury to the vitality of the various organs; a knowledge of food by which the body is nourished; of water; of air; of clothing for keeping the body warm and dry; of the soil on which we live; of the materials with which we construct our houses; of the habits of life in which we indulge; of the methods of preventing our various surroundings from becoming polluted by the mere action of our existence.

The recapitulation of these various subjects shows that Instruction in Hygiene involves a vast field of knowledge, and that it trenches upon almost every science; for it includes some Physical science, it includes some Biology, Chemistry, Geology, Botany, as well as some education in Architecture and Engineering.

When, therefore, we propose to teach Hygiene in Elementary schools, we must consider how we can make a subject, which includes so much, reasonably intelligible to children of the ages of those with whom we have to deal.

To begin with, the children are already taught theoretically as much as they can be expected to assimilate. Indeed they are kept at the desk for a longer period than is either useful or desirable for young children. The child's brain can only take in a certain amount of information.

Sir E. Chadwick showed many years ago that pupils working half-time learned as much as those working full school hours. Dr. Schofield's lectures to The Sanitary Institute similarly show that although the child may be kept at his lessons for five or six hours, his brain is really not capable of continuing to absorb information for more than two hours a day.

It may be said that the system upon which the elementary schools have been constituted was devised with the object of teaching the children as much as possible in their earlier years, in order that they may go to work and earn money as soon as they can. The originators of the system appear never to have considered the incapacity of the child's brain to absorb all that it was desired to cram into it. And the result which has followed in very many instances has been, that young men, especially in the agricultural districts, after having left school for a very few years, have forgotten almost all that they learned at school.

If this is the present result, the children are already kept at work longer than is useful; therefore it does not seem reasonable that further subjects for study should be added to the present school course.

It has, however, been equally shown that whilst children cannot be usefully kept at desk work for more than a very limited number of hours, yet that with an occupation changed to some form of practical work, they are capable of assimilating what they are taught in that way.

Whilst, therefore, it seems probable that mere theoretical lectures to children on purity of air or water would not convey much definite information to a child's mind, the question arises whether, if Hygienic teaching were reduced into a practical form, the children might not be trained into Sanitary ideas when they went back to their insanitary homes.

Hygienists are all aware that the sum of their science is included in the words purity and cleanliness. It does not seem impossible that this should be impressed in such a practical manner on children in elementary schools that they might be trained in the desire to carry home some of that cleanliness.

Moreover, it cannot be too strongly impressed on the community that whilst, on the one hand, the effect of the school elementary course has been the teaching of the child, the other main object of education, viz., the training, has been much neglected.

Practical instruction in Hygiene in elementary schools appears to be capable of being applied so as to become a system for training the children in habits of discipline, of obedience, of order, and of cleanliness.

The most useful way in which to convey this practical hygienic training would probably be conveyed in some form of applied cleanliness.

The deck of a man-of-war is said to be so clean that the men can eat their dinners off it. The floor of an elementary school room might be kept equally clean if it were used as a means of educating the children in cleanliness.

The pupils should be taught to clean every part of the school premises. They might thus be taught to realize practically the dangers of the accumulations of dirt against the walls, or near the cellar, or the well; the danger of accumulations of rubbish or dirt in cellars and in corners or other dark places inside the house; they should be accustomed to clean floors, to clean furniture, to clean windows, to clean the cisterns, sinks, traps and gullies, as well as the surroundings of the house. They could be taught the advantage of clean clothes, and how to make them clean; and, more than all, they should be taught personal cleanliness.

Perhaps there is no characteristic which is so deficient in our population as that of personal cleanliness. Nor is it very surprising, for it is only in recent years that the taking of baths by the poor has been possible, except in summer in the vicinity of rivers, canals, or the sea. Public baths are of comparatively recent creation, even in towns; in the country districts public baths are practically unknown.

The first thing to do to introduce hygienic tendencies in the population would be to introduce personal cleanliness. If this is to be introduced throughout the population, it must be done through the children. The mere fact of making the child clean, would be to make it as it grows up desire to carry out the habit of cleanliness in its surroundings.

In order to obtain this personal cleanliness baths should be added to every elementary school. The children should be compulsorily made to wash at least once a week. The system which would effect the object best would be that which includes the simultaneous washing of several children, say from ten to fifteen or more. The baths consist of several recesses, in which the boys stand under a shower and spray bath.

The arrangement is as follows: the children are marched into a room, where they undress by word of command; they are then marched into an adjacent room which contains the bath recesses, in which they soap themselves by word of command; the shower and spray baths are then set in motion, and the children subsequently marched out to their dressing room. This system is in use in the Gordon Boys' Home, and in other school establishments.

The water is warm or tepid according to the season. By having two undressing rooms the baths can be used with great rapidity, and with three undressing rooms each shower bath could be used every five minutes.

This system would be applicable to all children of the ages of elementary school children, except that as regards girls the care of their hair is a very important question. This is far too little attended to, among even the well-to-do, and is often seriously neglected among the poorer classes; but into this question I will not enter.

The conclusions to which I would desire to bring you are: that the present school hours might advantageously be curtailed so far as the effect on the brains of the children is concerned; that this curtailment might be utilized for training the children in habits of cleanliness and of obedience. I should effect this by making the teaching of Hygiene in elementary schools practical teaching. It should include compulsory personal cleanliness; to this should be added physical exercises, because by means of these the body is developed. The habit of cleanliness and the use of physical exercise might be jointly utilized to inculcate those habits of rapid obedience which are invaluable in the formation of character.

It is quite certain that until cleanliness can be introduced

as a habit into the population, they will never really appreciate hygienic arrangements; and in the appreciation of general cleanliness, personal cleanliness is a most important element. The elementary schools seem to afford almost the only means of diffusing a general feeling for personal cleanliness amongst the young, and my impression is strong that, when once that habit of cleanliness is established, it will not be abandoned with increasing years, but that a population which has liked and has been accustomed to washing in youth will feel it to be an indispensable element of comfort and happiness, and will adhere to the custom through life.

We cannot too strongly or too constantly urge upon the authorities in elementary schools that preaching without practice, in hygiene especially, is of little avail.

Dr. J. F. J. Sykes (St. Pancras), at the conclusion of the paper, said he wished to add a little of what was done elsewhere. When in Budapest he was struck by the fact that the Hungarians were the first to establish, and had now in thorough working order, a State Service of Medical Officers of Schools. It was the duty of those officers to supervise the sanitary conditions of the schools, and of the scholars, and also to teach hygiene in its practical form in all middle-class schools. That, he thought, was an example which might well be followed in this country.

Mrs. Sprunt (Liverpool), as the Principal of a private school for boys and girls in Liverpool, thought that the training of a child in health should begin on the day it was born. As a householder she had had considerable experience of servants who had passed the higher grades in Board Schools. She had practically to teach them how to do everything, and this, she thought, was a fatal defect in the education of the present day. Without entering into technical matters, she tried to teach the children under her care the general principles of science. When she told them she was going to the Congress, where she would meet men from all parts of the country who knew more than she did, they at once to her question, "And why do you think I am going?" replied, "Because you will be better able to teach us." She was strongly of opinion that hygiene should be taught in a practical way from the very earliest years, not only in Board Schools, but in private schools, and she hoped there would be a vast difference in the England of the future in regard to this matter.

Mr. Washington Lyon (London) said that schools should teach sanitary science by the Kindergarten system, which would not only amuse the children, but teach them something practical and useful. In America when, any improvement was required, the question was, "Can it be done?" if so, do it; not what will be the cost. In this country, however, we were in the habit of holding back sanitary improvement while we are discussing the cost; in the meantime, lives were perhaps being lost and health sacrificed.

Dr. Hodgson (Crewe) said the paper had opened up a question of very considerable interest to all who were engaged in the prevention of disease. He thought they would agree with the expression of opinion that the duration of school teaching in most elementary schools was too long, and could be shortened certainly with advantage to most of the children, and especially the younger children. He agreed that something of the nature of what Dr. Sykes had mentioned as in vogue in Budapest was a possibility, if not an actuality, in many of our districts, for the Medical Officer of Health certainly had the duty laid upon him of inspecting the sanitary conditions of all elementary schools. With reference to the washing process laid down by Sir Douglas Galton, he did not think it was possible in our elementary day schools. Most schools in towns were built up almost to the last inch, and he did not think they could provide bath accommodation of the kind suggested, although at the same time he considered it desirable. In the erection of new schools the thing might he done by School Boards, but it could hardly be expected from voluntary schools, who were already working under great difficulties. Undoubtedly there should be a general system of instruction in hygiene in all schools. The teaching of hygiene to adults was doing an incalculable amount of good, but it did not begin early enough in life. Every child had the right to be taught the essentials of the conditions for healthy living, and he hoped the attention which had now been drawn to the subject would have some practical issue.

Mr. Rickaby (Sunderland) considered that the Congress could not do better than lay their views on this question before Corporations who had the spending of the Technical Education money. In his own town, where they had a sum of money at their disposal, they had appointed a committee to take the matter into consideration, but they were still hanging fire. He did not know that any more important education could be given to a child than that which related to its physical development, and he was quite sure that the Corporations would be only too thankful to have this matter brought prominently before their attention.

Councillor R. Thomas (Newcastle-on-Tyne) did not think that the people ought to be more heavily taxed for the education of children than they were at the present time. The Code of 1870 contemplated teaching children the three R's, but that limit had been far surpassed and now almost everything was taught by some School Boards, including dancing and music. In Newcastle they had at their disposal about £3,500 per annum, which they received from the Customs and Excise duty, and that they had distributed amongst nine or ten institutions which already existed. In return for that some twenty scholarships were founded for children for the elementary schools who had passed the sixth standard, and who received practically the full benefit of a college education.

Councillor W. MACLAY (Glasgow) mentioned that the School Board with which he was connected were about to erect a new school and they were taking great interest in all modern improvements, one of which was the providing of a swimming bath. In the city of Glasgow there was not a swimming bath in any one of their schools, but he was pleased to say that at their last meeting (although it was only by the casting vote of the chairman) they decided to have a swimming bath in their new school. He was certain it would tend to cleanliness and health and be most useful. No doubt there was a feeling that while children were sent to school to be instructed they were pretty certain to catch some children's troubles. That being so it seemed to him that in schools the laws of health should be thoroughly observed, and as tending in that direction the appointment of medical officers to visit schools occasionally would doubtless be an important step in the right direction.

Mr. S. P. SKIPWORTH (Owmby Mount, Searby, Lincoln) said the question had hitherto been treated entirely from the point of view of towns and large communities. The rural districts did not seem to have been thought about. In the district with which he was connected they had arrived at a point where they absolutely did not know how to spend the money they had received for Technical Education. They had had most interesting lectures on hygiene and kindred subjects by talented lecturers, amongst others Miss Kenealey, and the difficulty in the country villages had been to get an audience together. He wished to strongly impress on the Congress the absolute necessity of beginning at a very much earlier age than they were in the habit of doing, because he found from his own practical experience it was almost impossible to teach a grown-up person. Before they commenced another year's series of Technical Instruction, he intended to suggest that some of the money should be given to the schools for the teaching of hygiene by schoolmasters and mistresses (who had proved themselves to be qualified), if the regulations of the Education Department would admit of this course being adopted.

Dr. WILLOUGHBY (Eastbourne) pointed out that the Plymouth School Board to which he formerly belonged prided itself very much upon its evening continuation schools and taught hygiene. Evening continuation schools in which adults were crammed up on points which more properly belonged to Sanitary Inspectors, were of course simply ridiculous. If anything practical was to come out of the discussion he thought it ought to be represented to School Boards and other public bodies that the hygiene which should be taught was practical hygiene, which should be taught in the elementary day schools and not only to adults in the continuation night schools.

Dr. OULTON (M.O.H., West Dublin) said that domestic economy was now very generally taught in schools. The books which were used dealt very much with sanitary matters ; in fact, went fully into many matters connected with sanitation. For this they had to thank the system of intermediate education. He had the opportunity recently of seeing the papers which were given to the children in Ireland for this examination, and he was surprised to see how fully the answers went into the subject. It was with the very poor that difficulty would be experienced in this matter. Until they could persuade them of the necessity of changing their dirty habits he was afraid not much improvement need be expected. District visitors might do a great deal in this direction, and Parish Councils might offer prizes for cleanliness, and so on.

THE CHAIRMAN (Dr. R. S. Marsden), before closing the discussion, said that with the exception perhaps of the medical officer for the London School Board he occupied an almost unique position in this country as medical officer to the School Board of Birkenhead. He agreed entirely with the paper of Sir Douglas Galton but he thought the systematic teaching of hygiene in schools in the form of book and lecture instruction could be carried too far. The amount of information which was being crammed into children was more than enough already, and he certainly thought it would be preferable to give object lessons in Sanitary Science after the manner of the Kindergarten system. His experience from visiting schools (which he did constantly) was that the children in many cases were being over crammed and that they required a rest such as would result from object lessons of the description to which he had alluded, and which might be both instructive and restful.

"*On the Laws relating to the acquisition of Land for Isolation Hospitals, Workmen's Dwellings, and Public Improvements,*" *by* Alderman CHARLES BURT, J.P., Richmond.

To obtain sites for Isolation Hospitals, Workmen's Dwellings, improvement of insanitary areas, widening of streets and other public purposes, compulsory powers of taking land are required in nearly all cases.

It is obvious that in the public interest all reasonable powers and facilities should be given to local authorities for this purpose, and that no needless delay and no unnecessary expense should be allowed to prejudice the exercise of such powers. I propose to show that the law on this subject is in urgent need of amendment, and I hope to induce the Congress to use its influence to secure this reform at the earliest opportunity. The Public Health Act, 1875, gives to sanitary authorities ample powers of obtaining land by *agreement*; but by Section 176 it places those authorities on nearly the same level as railway and other companies in regard of compulsory powers, and here I submit is a fundamental error.

That private persons should not be required, except on special and stringent conditions, to part with their property to companies intending to make a profit out of it is reasonable, but to put local authorities requiring land for public purposes on the same footing is, I think, altogether wrong. The necessities of the community ought to be the first consideration in such matters.

A railway company has to get an Act of Parliament to obtain compulsory powers for taking land. There is no preliminary enquiry. The only way by which a landowner can resist is by petitioning Parliament against the Bill, and appearing upon his petition in Committee of the House of Commons or House of Lords, or both, at his own expense.

Except in the special cases I shall mention later on, where the procedure has by recent Acts been somewhat mitigated, a local authority desiring compulsory powers for taking land for any purpose must go through the following ordeal:—

It must, under Section 176 of the Public Health Act, publish in three successive weeks in September, October, or November, an advertisement describing the undertaking for which the property is wanted, refer to a plan of the land, and state its extent. In the next following month notices must be served on every owner, lessee and occupier of the land proposed to be taken.

The local authority may then petition the Local Government Board for a provisional order giving compulsory power to take the land described, and the Board may either dismiss the petition or direct a local enquiry to be held. At this enquiry any person interested may oppose the application, and in some important cases the enquiry has lasted for several weeks, and the costs incurred have amounted to thousands of pounds.

If satisfied that compulsory power ought to be granted the Local Government Board makes a provisional order authorizing the local authority to take the land; of course upon payment of full compensation to all parties interested.

One might expect that after this tedious and sometimes expensive process extending over many months has been gone through the order would be immediately available; but no, so tender and considerate is the English law towards landowners that the provisional order has no effect until it has been confirmed by Act of Parliament.

An objecting landowner may oppose the confirmation of the order in Committee of both Houses of Parliament, and put the authority to very heavy expense in supporting the order, and may succeed in getting it rejected.

An Act confirming a provisional order is not usually passed until July or August, so that there is a delay of nearly twelve months before the compulsory power is obtained, and then a fresh set of troubles begins. The provisions of the Lands Clauses Consolidation Act, 1845, are incorporated with Section 176 of the Public Health Act, and when the provisional order of the Local Government Board has been confirmed by Parliament, there is no difference between the steps to be taken by a Town Council or Local Board requiring a few feet of ground to round a corner, or widen a narrow street, or land for a hospital site, or sewage farm, and those imposed on a railway company which proposes to make a great slashing cut one hundred yards wide through fifty miles of country for a new railway. Notices have again to be given to owners, lessees, and occupiers, and if no agreement as to compensation is come to, then if the compensation claimed does not exceed £50 (which very rarely happens), the amount is to be settled by two justices.

But if as is almost always the case, the compensation claimed exceeds £50, it is to be determined by arbitration if the claimant so require, or otherwise by a jury of twelve persons under the very voluminous conditions set out in the Act. After some experience of these matters, I have come to the conclusion that for a local authority, there is nothing worse than a compensation trial by jury—except an arbitration under the Lands Clauses Acts.

In either case the public body is usually looked upon as fair game to be squeezed and plundered.

Surveyors for the claimant put on their strongest magnifying glasses, and charge their biggest fees, and get them; and the professional witnesses, the lawyers, and the party generally, have a "good time" at the expense of the unfortunate local authority.

The trial by jury is usually short, and this is a great mercy, but arbitrations linger on for many days, and the costs are enormous in proportion to the subject matter of the reference.

Then the Act provides that unless the amount awarded be the same or less than the sum offered to the claimant before the enquiry commenced, all the costs of both sides and of the arbitrators or jury, shall be paid by the local authority.

If this exceptional case should occur the defeated claimant gets off by paying his own costs and half the costs of the enquiry, leaving the successful public body to bear the other half and all their own expenses.

There is no limit to the number of witnesses a claimant may call or to the length of his counsel's speeches, and as the arbitrators and counsel are paid according to the number of sittings held, and one of the arbitrators is the representative of the claimant, the costs of these enquiries become a very heavy burden and naturally prevent prudent local authorities from embarking on them unless it be absolutely necessary.

The result is that many improvements and public works which, if obtainable at a reasonable cost, would be promptly carried out, are postponed, or never taken in hand, because of the wearisome delays and heavy expenses which would inevitably be incurred under the present law.

There are usually an owner and a lessee or an occupier having separate interests in real property. Every such person is entitled to full compensation for his interest in the property taken, or for injury to any other property belonging to him and injuriously affected by the proposed works.

The lessees' and the occupiers' interests are to be dealt with separately from the owners', and although the machinery is simpler and less costly, the expense of obtaining a separate adjudication as to each of these interests adds considerably to the cost incurred in acquiring the property.

I mention two cases illustrating the cost of acquiring land compulsorily under the existing law; they are by no means exceptional.

In a small town in Surrey a piece of garden in front of some poor cottages was wanted to straighten and widen the High Street; the area required was fifty-two square yards. The local authority negotiated in vain with the owner, a wealthy Baronet, and had to pay as compensation for this wretched bit

of land, as awarded by a jury £600 0 0
The costs incurred were 278 0 0
878 0 0
and the cost of making up the new pathway
and roadway was another £100 0 0

After the improvement of the road was made, the residue of the property was worth as much or more than the whole of it previous to the alteration.

In another town, a tradesman bought two old shops in the principal street (which is very narrow) at a cost of £1,700. The total area purchased was 186 square yards. As the houses were pulled down for rebuilding, the local authority gave notice, under Section 155 of the Public Health Act, to set back the building line some eight or nine feet so as to widen the road. The space required from the owner was twenty-seven square yards (one-seventh of the whole), and for this the local authority offered £400. The owner claimed £1,000, and as this was utterly unreasonable, the matter went to arbitration. The umpire awarded £650, and the claimant's costs (including the award) came to £247, whilst the local authority's costs amounted to £146 more, making a total of nearly £400 for costs in fixing the value of this morsel of land. The result has been that the further widening of the street has been almost entirely stopped for fifteen years, and the public are annoyed and injured by the block of traffic, and so it remains to this day.

The last case leads me to refer more particularly to Section 155 of the Public Health Act, which authorizes urban authorities to regulate the line of buildings in any street, in cases where "any house or building or the front thereof has been taken down in order to be rebuilt or altered," compensation being paid for the damage occasioned. This is only another form of acquiring land for public purposes.

This section has given much trouble and expense to local authorities. First, the line of building cannot be prescribed until the old building is actually taken down, and the Courts have decided that the power cannot be exercised at all if the owner has, before notice, got in his foundations and substantially started the work of rebuilding. Although willing to pay full compensation for all work done or damage sustained the local authority is strictly held to the letter of the Act.

In the same town an enterprising mantle maker took a twenty-one years lease of an old baker's shop, built probably 150 years ago, and scarcely fit for habitation.

It was well known that the Corporation urgently wanted to widen the street at this point, and would do so under Section 155 if they could, but the lessee determined not to give up any part of the site, and he or his architect devised the ingenious plan of rebuilding three-fourths of the premises, making a lofty handsome shop extending from front to back, but leaving the attic story of the front portion unaltered—at all events until the rebuilding of the remainder was effected.

The Corporation were advised, by a former Liverpool city surveyor, that the work was substantially a "taking down of the building," and they prescribed a line for the new building, setting back the front about ten feet, but behind the usual hoarding the enterprising mantle maker went vigorously to work, and while the parties were negotiating, and before the necessary notice was given, his builder got the old ground floor and first floor taken out, and the attics secured by new side walls and a girder across the front.

The Corporation brought an action to restrain the further building, and Mr. Justice Kekewich decided that they were originally entitled under the Act to have the building set back as proposed, but that they were too late in giving the notice, and therefore (although the Corporation offered to pay all the expenses incurred in regard to the new building) refused an injunction. Then the Corporation went to the Court of Appeal, which also refused the injunction, but upon the totally different ground that the Corporation had no right to have the building set back, as the mantle maker had not taken down the building or the front thereof to the ground floor within the meaning of the Act.

He had in fact succeeded in dishing the Corporation, who ultimately bought his lease at a large premium and repaid all his outlay. Now the landlord refuses his consent to the setting back, and we are as far off as ever from the desired widening of our main street.

In all these cases, and throughout all the Acts of Parliament, except the most recent, the public interest appears to be subordinated to that of the landowner, and instead of facilitating improvements and aiding local authorities in works for the public benefit, there seems to be a deliberate design to make the acquirement of land as difficult and expensive as possible. Many of our towns are sadly in need of isolation hospitals, and would erect them immediately if suitable sites could be obtained on reasonable terms and in a reasonable time. It is seldom that a landowner is found willing to sell land for a hospital or for sewage works, no matter how urgent is the public need, so that authorities are obliged to resort to compulsory measures or go far a-field to get what they want, and thus raise further complaints and objections.

In places near London there is great difficulty in finding sites for isolation hospitals. The Local Authority of one of these places has just spent £600 or £700 and six months' labour in a fruitless effort to procure a site, or rather the formal sanction to a loan, to buy land and build upon it. I believe they would have succeeded long ago if the law had given proper facilities.

Meanwhile, disease is spread and encouraged in towns by the necessity of keeping infected patients in their own dwellings, there being no hospital where they can be placed.

A Bill introduced by Lord Thring and passed last session, gives power to County Councils to provide isolation hospitals, and to make combinations of districts for the purpose, but the Act makes no change in regard to the power of acquiring land compulsorily.

I will mention one other point in the land law calling for amendment. By Section 92 of the Lands Clauses Act, 1845, it is provided that no person shall be required to sell a part of a house or other building or manufactory if he is willing and able to sell the whole.

This section is incorporated in the Public Health Act, 1875, and is a further evidence of the special tenderness with which the sacred rights of landowners are regarded by the legislature. Cases occur where a small part only is required of the curtilage of a large house or building, and yet, although full compensation would have been paid for the part taken and for the damage (if any) to the residue, yet the landowner has required the whole property to be purchased and paid for. It has been decided that not only must the entire house or building be taken and paid for, but also the yards, garden, &c., occupied therewith.

I now come to the exceptional cases in which the Legislature has somewhat modified the stringency of the laws for protection of landowners.

By the "Housing of the Working Classes Act, 1890," an arbitrator may, for the purposes of that Act, determine that Section 92 of the Lands Clauses Act, 1845 (which has just been referred to) shall not have effect if he considers that the part required can be taken without material damage to the house, building, or manufactory; and in such case he is to award compensation for the severance as well as for the part of the property taken. An appeal to a jury against the arbitrator's decision is allowed if the High Court give leave, but as I read the Act the unsuccessful appellant, whether owner or local authority, has to pay the costs of the trial.

This is reasonable and just, and I submit that the like provisions ought to be made applicable to all cases under Public Health, Sanitary, and Improvement Acts.

The arbitrator, dealing with cases under the Housing Act of 1890, is given large powers, with a view to arriving at a reasonable settlement between the local authority and the several claimants, and he may deal with fifty or 100 claims in one award. An appeal from the arbitrator's decision is allowed only when the amount awarded exceeds £1,000, and then only by leave of the High Court; and if the appellant, whether landowner or local authority, fail in his or their contention, the defeated party has to pay the costs incurred on the appeal; but even if successful, the local authority has to pay £20 for costs if the officer hearing the case so directs. The Local Government Board is also given a very useful controlling power over the costs of arbitrations, and an arbitrator may refuse costs to a claimant if he have not promptly delivered particulars of his claim.

Under the Housing Act it is provided that the compensation payable for premises taken compulsorily shall be the fair market value thereof in its then actual condition, without the 10 per cent. usually added for compulsory purchase. The great principle of betterment is also recognised, for where an obstructive building is removed at the cost of the local authority, and the arbitrator is of opinion that its demolition adds to the value of other premises, he may award that (to the extent of such additional value), the cost of the demolition shall be borne by the premises so increased in value.

The whole Act is a valuable one, and will I hope be largely made use of in cities and towns where unhealthy areas and obstructive buildings exist. In London its application is subject to the approval of the Home Office instead of the Local Government Board.

The "Allotments Act, 1887," was, I believe, the first to give county authorities power to make provisional orders for taking land, but the order (as is the case with provisional orders of the Local Government Board) is of no effect until confirmed by Parliament.

This Act also contains some provisions which should be generally applicable, viz.:—

For the compulsory appointment of a single or sole arbitrator, whose remuneration is fixed by the Local Government Board, and who is required to determine the amount of costs payable, and has power to disallow any expenses unnecessarily incurred.

It also provides (Section 4) that if a provisional order be opposed in Parliament the Committee on the Bill may award costs to be paid by the opponents or by the promoters as they may think fit.

One of the great bones of contention on the "Small Holdings Act, 1892," was the omission therefrom of any compulsory powers of taking land. This defect has not yet been remedied.

Mr. Ritchie's "Local Government Act, 1888," under which County Councils were established, marked a great advance in local self-government, but whilst many and important powers were given to County Councils no larger powers of taking land by compulsion were granted to them, than were previously held by the smallest Local Board of Health.

Mr. Fowler's Act of 1894 (Parish Councils Act), goes much farther.

By Section 9 the functions of the Local Government Board as to granting provisional orders are for many purposes extended to County Councils, who may now after public enquiry make orders for compulsory acquisition of lands for any Parish Council purposes. An order so made when confirmed by the Local Government Board will have the effect of an Act of Parliament at once, unless some person interested petition the Local Government Board against it, and then the Board confirms or refuses the order at its discretion. Here we have for the first time the principle that land may be taken compulsorily for public purposes without an Act of Parliament. Moreover it is provided that there shall be no additional allowance, beyond the actual value of the property, in respect of compulsory purchase, and that whilst the parties and their agents and witnesses may be heard before the arbitrator, counsel and expert witnesses shall not appear except in prescribed cases. The clauses of the Allotments Act, 1887, as to procedure and costs are incorporated.

You will see that we are by slow degrees getting on to a more rational state of things, but the Acts I have referred to are applicable only to certain defined objects, and are not available for many, perhaps the most important, public purposes. At present a Parish Council is more favourably treated by Parliament than the Corporation of the city of Liverpool. What I ask therefore is that an Act should be passed making the recent scattered improvements in the law of expropriation apply to all lands required for necessary and useful public purposes, and consolidating and amending the various Acts on the subject, making them into a clear and intelligible whole, and particularly that the new Act should embrace the following provisions, viz:—

1. That orders of the Local Government Board and of County Councils (subject to confirmation by the Local Government Board) for compulsory acquisition of land required by local authorities for public purposes, made after due notice, and public enquiry should have the force of law without an Act of Parliament.

2. That application for such orders may be made at any time on giving the prescribed notices, instead of being confined as at present to the months of September, October, and November.

3. That the abolition of the additional price for compulsory sale should be extended to all the above cases, and the Betterment Clauses of the Housing Act of 1890, or some analogous provisions applied thereto where appropriate.

4. That the provisions of the Parish Councils Act of 1894 as

to costs of counsel and witnesses should also be made of general application.

5. That the Local Government Board or the County Council, as the case may be, should be enabled to exclude the operation of Section 92 of the Lands Clauses Act, 1845, in any cases where they think fit to do so.

6. That County Courts should be authorized to deal with all compensation cases up to £500, and that all the authorized tribunals be enabled to dispose of the claims of owners, lessees, and occupiers, in respect of the same property at one and the same time.

I submit that these amendments of the Law are reasonable and just, and would tend to facilitate very largely the carrying out of public works and improvements by local authorities, and would reduce the cost and delay of acquiring land, and at the same time provide for full and fair compensation and protection to all parties interested in the property to be acquired. The mere existence of such an Act as I have suggested would do more than anything else to bring about agreements between public bodies and owners of land on reasonable terms, because landowners would know that if such terms were not accepted the public authority could promptly and inexpensively bring compulsory powers into operation.

Mr. **Washington Lyon** (London) said the powers suggested in the paper should be granted. In his opinion there was no danger in an infectious hospital being placed in any locality, if proper precautions and regulations for administration were carried out internally.

Mr. **Jas. Lemon** (Southampton) said that it certainly was very refreshing to hear an eminent lawyer and Parliamentary agent, like Alderman Burt, complaining of the big fees charged by lawyers. He believed the time was now coming when an alteration of the law was eminently desirable, especially when they considered the obstruction they met with when a Local Authority desired to acquire land for any useful purpose. Take the case of an isolation hospital. It was absolutely impossible for a Local Authority to obtain land for such a purpose, without paying an enormous price for it, and enormous fees. This obstruction to the progress of sanitary science and the isolation of disease, had the effect of stopping what would otherwise be many desirable improvements, and therefore any alteration which could be properly carried out, as suggested by Alderman Burt, was eminently desirable. The expense attending arbitrations was so great that owners of land were induced to ask large sums, because they knew that a Local Authority would very often rather pay than run the risk of going to arbitration, and being saddled with fees. He was an owner of property himself, and would be very sorry to see any law established by which a landowner would be robbed of that which he possessed. He, however, held his property subject to the reasonable rights and wants of the community, and he did not want to stand in the way of preventing disease, and thereby benefiting the whole of his fellow-townsmen. He had prepared the following resolution. which he hoped someone would second:—"That this Section approves the conclusions of Alderman Burt's paper, and recommends the Congress to pass a resolution in favour of their adoption."

Dr. J. **Brown** (Bacup) seconded the resolution. The conclusions at which Alderman Burt had arrived ought to meet with the approval of everyone present. He had had some experience of the methods which were resorted to by owners of property to prevent the carrying out of public improvements, unless extortionate compensation was paid. A case came under his notice only a short time ago, where the cost of acquiring a very small piece of land was something like four times the amount of money which had been paid for it previously. In the North of England some of the great landowners were beginning to realise that whilst property had its rights it also had its duties to the commonwealth. In many instances they had been very generous when improvements for the public good were concerned. One must see that there was a great difference in the acquisition of a piece of land for infectious diseases' hospitals, and land that might be required for mere street improvements: but he believed that the time was coming when there would be an alteration of the law concerning the acquisition of land for all public purposes in regard to sanitation.

Alderman **Burt** (Richmond) speaking as to sites for Small-pox Hospitals, said that Local Authorities advised by Medical Officers of Health of intelligence and common sense were not likely to propose anything unreasonable. If they did, there was always an enquiry by the Local Government Board as to whether the land should be taken or not. That made the matter safe for the landowner and for the public. He might mention that Parish Councils had greater powers in regard to this subject than the City of Liverpool, and it was absurd that such a state of things should continue. His object in bringing the matter before the Congress was that it might go forward to the Local Government Board and Members of the Government in order that if possible (assuming that Welsh disestablishment and discussions on the powers of the House of Lords did not take up all the time) a short Bill might be passed next session on the lines of his suggestions, which were he considered the minimum of reasonable reforms in the existing law. He would be glad if Members of the Section would hand copies of his paper to the Clerks of Town Councils and Local Boards in their respective localities.

On the suggestion of the Chairman the wording of the resolution was altered so that it should read :—" That this Section approves the conclusions of Alderman Burt's paper on the laws relating to the acquisition of land for isolation hospitals, workmen's dwellings, and public improvements, and recommends the Council of The Sanitary Institute to take measures to secure the early adoption thereof." In this form the resolution was carried.

NOTE.—*The opinion of the Council upon the resolution passed at the Congress will be published in Vol. XVI., Part I.*

On " Quarantine in the Argentine Republic," by F. P. HANSEN, Argentine Consul.

Preliminary Remarks.—The constantly increasing importance of the commercial relations between this country and my native land, the Argentine Republic, induce me to offer, though not a medical man, a few remarks on the Argentine precautionary system against the introduction or spread of pestilential disorders.

Extent of the Country.—I may premise that, though a large country, having an area of one million one hundred and seventeen thousand square miles (1,117,000), embracing from the 22nd to the 55th southern parallel, and measuring in its extreme length two thousand two hundred and eighty-one (2,281) miles by nine hundred and fifty (950) in its greatest width, the Argentine Republic is quite free from pestilential diseases or epidemics, being fortunately situated in the southern temperate zone; with the sole exception of the extreme north, where, for a distance of one hundred (100) miles it lies within the tropics.

Climates.—In such a considerable territory, as large as those of the United Kingdom, France, Germany, Austria, Italy and Spain put together—there are, of course, a variety of climates. However, roughly speaking, we find that if we were to traverse the country from north to south we should cross 400 miles of a hot climate, 400 miles of warm to hot, 500 mild (comprising the City of Buenos Aires, the capital), 600 mild to cold, and 381 cold. This division must not, of course, be taken as absolute; for even in the hot zone we find cool or cold weather in the mountainous regions; as, for instance, we find it hot in the City of Salta, 976 miles N.N.W. of Buenos Aires, where Mr. Jabez S. Balfour is at present in confinement, while if we travel a few miles towards the surrounding mountains, we will get as cold weather as we want.

Diseases.—The country has no special diseases. Speaking generally, fevers are more prevalent in the North than in the South, while consumption is almost unknown. On the other hand, in the South there are not many fevers, but diseases of the digestive and respiratory organs are more prevalent than in the North.

Small-pox.—There is not much small-pox anywhere, as the people are at one with the authorities with regard to the efficacy of vaccination as a preventive of that complaint. This feeling has grown stronger ever since a few years ago when the National Government established a Conservatory of Vaccine, where specially selected calves are kept for the purpose of providing animal vaccine, which is distributed under the auspices of the National Board of Health to all the municipal authorities throughout the country, the said authorities being charged with the care of the public health within their respective towns and districts.

The National Board of Health.—The National Board of Health is supreme in all quarantine affairs. The regulations, of which I will now proceed to give a summary, are based on the time-honoured precept that "prevention is better than cure." They may, perhaps, appear somewhat stringent here in the United Kingdom where quarantine does not obtain.

Necessity for good preventive measures.—It should be remembered that our experience, in the Argentine Republic, of foreign epidemical diseases has been such as to oblige us to take every possible precaution against the introduction of yellow-fever, cholera, &c., to our shores. In 1871, a few passengers, from a yellow-fever-infected country, landing surreptitiously at the city of Buenos Aires, brought on an epidemic which cost us the lives of about 18,000 inhabitants. In 1886, a cholera-infected ship from the Mediterranean, caused an outbreak of cholera, in which several thousands perished.

Quarantine regulations.—The port of Buenos Aires is sole port of entry for vessels coming from "suspicious" or infected ports, and in case of a very serious outbreak of pestilence in any country, all Argentine ports may be closed to vessels coming therefrom.

Suspicious Ports.—A "suspicious" port is one which has easy and frequent communication with an infected place, or does not take the requisite precautions in communicating with it.

Infected Ports.—An "infected" port is one where one or more cases of yellow-fever, cholera, or Asiatic plague have recently occurred. On a port being declared "suspicious" or "infected," the sanitary precautions apply to vessels leaving them eight days before the date of declaration for cholera; ten days for yellow fever, and twenty days for the plague; these being deemed the incubatory stages or periods of the said diseases.

Infected Ships.—An "infected" ship is one on board of which any case of pestilential disease has occurred during the voyage or after arrival.

Suspicious Ships.—A "suspicious" one is (*a*) one arriving from a "suspicious" or infected port, though no pestilential cases may have occurred on board; or (*b*) one which though coming from a "clean" port has communicated with a "suspicious" or "infected" port or vessel; or (*c*) one on board of which there have been deaths from causes not stated, or repeated cases of a disease; or (*d*) one not bringing a bill of health from each port, with the *visa* of the Argentine Consul; or (*e*) those conveying articles such as infected clothing, bedding, &c., or raw hides or furs.

Ships carrying 100 or more Persons.—Ships carrying 100 or more persons, including the crew, must have a doctor and the necessary medical appliances. Those enjoying "packet" privileges granted by the Argentine Government, must also carry a fumigating "stove."

Bills of Health.—Every ship leaving an Argentine port must take a "bill of health." Should there be in the port or vicinity a disease of an epidemical character, the fact must be set forth in said document by the port sanitary authority. Every vessel entering an Argentine port must have a bill of health from the port of origin and each port of call, duly "viséd" by the Argentine Consul, who must note on the back of the document anything he may have to remark in connection with the public health.

Consular Health Report.—All Argentine Consuls send in a monthly report to the National Board of Health at Buenos Aires, with respect to the state of the public health in their respective districts, noting specially the progress of diseases of an epidemical character or tendency, and give immediate telegraphic advice of any case appearing of yellow fever, cholera, or plague.

Medical Agents in Foreign Ports.—The National Board of Health may, when requisite, station a special medical agent at any foreign port.

Travelling Sanitary Inspectors.—On certain routes and at certain times it may place travelling sanitary inspectors on board the steamers, with orders to prevent the shipment of steerage passengers appearing to be afflicted by any contagious disease or to be just recovering therefrom; to carefully take note of the health of the passengers and crew; see to the proper sanitation of the vessel; give their professional services when requested; and isolate cases of contagious or pestilential disease, and see that the cabins where they have occurred be properly disinfected and the bedding, &c., disinfected also or burnt.

Arrival of Vessels.—On the arrival of a vessel from a foreign port it is met outside by the Health visit and questioned (without being boarded) as to origin, and state of health of those on board. When the reply is satisfactory the health officer goes on board, gets the bill or bills of health, and makes the necessary investigations and examination. Should the vessel be all right as regards health of passengers and crew, but in any insanitary condition, the persons on board may land, but the cargo must not be discharged until the vessel has been placed in a sanitary condition.

Quarantine.—Should the visit on board show want of good faith in the information furnished, the examination is suspended, the vessel is ordered off to the nearest quarantine anchorage, and the health officer who went on board is detained in quarantine to wait the report of the Medical Officer of the Floating Hospital or Hospital Ship.

Should the reply first given from on board to the health visit be unsatisfactory, or the ship come from a suspicious or an infected port, it is not boarded but ordered off to the nearest quarantine anchorage, to be visited by the officer of the Hospital ship should there be no *Sanitary Inspector* on board.

Vessels from Suspicious or Infected Ports.—Ships coming from a "suspicious" or an "infected" port, and not having a *Sanitary Inspector* on board have to undergo ten days' quarantine for yellow fever; eight for cholera; and twenty for asiatic plague; to be counted from the latest complete disinfection of the ship by the Argentine sanitary officers. When carrying a *Sanitary Inspector* the period of quarantine is counted from the date of the ship's departure from last "suspicious" or "infected" port, if the voyage be shorter than said period and the health of those on board has been, and is, all right, for instance, should the ship come from a cholera infected port after a six days' voyage, the detention in quarantine lasts only *two* days instead of *eight*. If the voyage has been longer than the respective period of quarantine and no cases have occurred on board, quarantine is dispensed with and the ship granted free pratique. Should cases have occurred on board, the quarantine period counts from the date of the last complete disinfection following on the last case.

The Passengers.—" Healthy,' quarantined passengers are landed and housed at the *Lazaretto* or Quarantine grounds at the island of Martin-Garcia, some forty miles from Buenos Aires city; or remain on board should the *Lazaretto* be full. Those ill of non-pestilential disorders are housed in separate buildings, the contagious cases away from the non-contagious. Those ill of pestilential malady are taken to the Floating Hospital. Should any contagious case appear amongst the " healthy " passengers, whether pestilential or not, the patient is removed immediately to the respective infirmary or the Floating Hospital, as the case may be; and his or her fellow-passengers are, as well as their attendants, kept apart from the rest.

Disinfection of Effects.—All the personal effects of quarantined passengers are disinfected on arrival; and those of the sick are again disinfected on leaving.

Convalescent Cases.—Persons convalescent of pestilential disorders undergo full quarantine in the Floating Hospital prior to landing.

Ships in Port.—Ships in port are visited daily by a Health Officer. Should a disease of a pestilential nature appear on board, the ship must go to the nearest quarantine anchorage. If not of a pestilential nature, and the disease should exist on land at the time, the sick are taken to hospital and a Health Officer is placed on board; should it not exist on land, communication with the shore or with " clean " ships is prohibited.

Sickness on Board.—No sick person may be kept on board or be removed from a ship, except by authority of the Health Officer; nor may any medical man go on board for professional purposes without giving notice to the Port Sanitary Authority and being accompanied by one of its officers, except in cases requiring surgical assistance.

Departure of Quarantined Ships.—Ships in quarantine, about to sail, may receive passengers, but the boats or tenders conveying them on board must undergo quarantine on returning, and no boats or tenders belonging to the ship itself are allowed to communicate with the shore.

Expenses.—Quarantine and disinfection expenses are charged to the ship giving rise to them.

On "*Jaundice and Bile-Staining as a sign of disease in meat*," *by* R. SYDNEY MARSDEN, M.B., D.SC., D.P.H., F.R.S.ED., Medical Officer of Health for Birkenhead.

(MEMBER.)

OF all the various alterations in the condition of meat which attract attention, the colour is one of the most prominent, as it immediately catches the eye of the meat inspector. Any deviation from the "normal" in this respect is sure at once to arrest his attention and cause him to make further and more careful examination.

It is for this reason that I have chosen my present subject for consideration, as well as from the fact that I am constantly being asked by my brother officers in other sanitary districts, what action we take in Birkenhead with regard to the seizure of bile-stained meat.

It must always be remembered that jaundice and bile-staining is not in itself a disease, but merely a symptom of some other disease, and consequently very great care has to be exercised to discover the *primary cause*, before judging of the importance to be attached to varying degrees of yellowness.

In certain breeds of cattle the fat and other tissues are naturally of a yellowish hue, as in the cases of Jersey and Guernsey beasts, these being generally of a darkish yellow; whilst cattle from certain parts of Canada and the United States, Colorado, Buenos Aires, and South America vary in the tinge of the fat from saffron yellow to that of rich gold.

In such cases the discolouration must be looked upon as a peculiarity rather than a disease, and if found in a large number of animals from the same lot, would generally call for no special action as regards condemning the carcases.

Sometimes the discolouration is due to the nature of the food taken, as is frequently seen in the case of "prize" animals which have been fed on condiments, and also in animals fed on brewery grain and spent malt, whilst patches of circumscribed yellowness will generally be found to be due to contact with the gall bladder, or to effusion of gall from it.

Failing these causes, the discolouration must be looked upon as a result of functional or organic disease of the liver, which may be due to a variety of causes, such as cold, splenic fever, Texan fever, puerperal fever, and the like.

Certain breeds of sheep which are exposed to much cold and damp often suffer a good deal from jaundice, as is frequently seen in the case of Cheviots, and also in sheep fed on the cold, low, damp flats of Lincolnshire. Pigs, too, which are exposed to severe cold or sudden chill, will often be found badly jaundiced in the carcass.

In the case of animals which have suffered from fever or from severe cold there will be other changes in the tissues along with the yellow discolouration which will at once point to the condemnation of the carcass; but in the case of animals which may be considered as normally having a yellow tinge in the fat, and in which there are not marked symptoms of other disease, it is frequently a nice point to decide whether the meat should pass or not.

Much depends on the appearance of the carcass after it has had twelve hours to set (and I may here remark that jaundiced meat as a rule *sets* well). If after this lapse of time the meat dries and looks well, and the flesh on being cut presents a fairly natural colour, not too dark, greenish yellow or brown, then there seems no reason why one should condemn the carcass as unfit for food simply on account of its yellow colour.

In the case of pigs, however, the tissues will generally be found sodden and wet, due to the much greater influence which cold has upon these animals, and the method of dressing the carcass may also exert some influence upon it; but the meat does not present a healthy appearance, and for these reasons we scarcely ever pass a jaundiced pig.

But in dealing with sheep, unless the discolouration is marked, together with other changes in the flesh, it is not usual to condemn the carcass for this cause alone. It will very frequently be found, however, that the liver of a jaundiced sheep is fluky.

There is a marked difference between carcasses suffering from ordinary jaundice and from that so common in cattle coming from the districts around the Mexican Gulf and affected with Texan fever; these differences may be shortly summarised as follows:—

	Ordinary Jaundice.	Texan Fever.
Bone	Yellow.	Natural.
Flesh	Greenish Yellow, sets well.	Chocolate Brown or Bronze, often not well set.
Fat	Saffron Yellow.	Deeper Yellow and Congested.
Bile..................................	Thin and Green.	Thick, viscid, flaky and dark.

I would just add, in conclusion, that it is very unwise to give an opinion on jaundiced animals from an examination made by gas or other artificial light.

Dr. J. **Brown** (Bacup) asked Dr. Marsden whether or not this meat had ever been found to taste bitter. He had had something to do in inspecting meat, and he must say that he had never seen bile-stained meat exposed for sale, nor had he ever come across a person who had had any meat which had tasted of bile. He would therefore like to know whether in bile-stained meat the taste was at all objectionable.

Dr. R. S. **Marsden** (Birkenhead), in reply, stated that the taste of bile-stained meat depended very much upon the degree to which the disease had gone. Bile-staining ordinarily would not go sufficiently far to materially affect the taste of the meat. But where they got bad cases, as they sometimes did, where the flesh was distinctly tinged, there was a decidedly objectionable taste, and then there could be no doubt that the meat ought to be condemned, as if eaten it set up enteritis. In Liverpool, and in his district particularly, they received very large quantities of meat which was extremely bile-stained and in very bad condition and which they had to condemn. That was especially the case in the foreign cattle coming from the districts around the Mexican Gulf. They had about 250,000 carcases per year in Birkenhead, about ten per cent. of which were more or less bile-stained, and it was possible out of that number some few might escape examination and get into other districts, thereby giving rise to considerable difficulties. Medical Officers had told him that the meat having already passed inspection at Birkenhead they sometimes did not quite know what to do with it. His advice was that wherever they found the characteristics of bile-stained meat as affecting the flesh colour, invariably condemn it, but in an ordinary case he saw no reason why they should condemn a carcase simply for a little colouring matter of the bile being in it.

On "Cholera in Hull, 1893, from an Inspector's point of view," by W. H. CURTIN.

(ASSOCIATE.)

ABSTRACT.

THE County Borough of Kingston-upon-Hull was founded in the year 1299. Its present estimated population is 212,732 persons, its area is 7901 acres, and its rateable value is £797,732. It is very flat, and being below high water mark difficult to drain, the outfalls being tide-locked six hours out of every twelve, so that pumping has to be resorted to.

The town is built upon a bed of alluvial clay from 6 to 10 feet thick, under which is found boulder clay at an average depth of 25 feet, with an underlying stratum of chalk over 300 feet in thickness.

The water supply is abundant in quantity and excellent in quality, and is pumped direct into the mains from the bores at Spring Head and Mill Dam Springs, distant about four miles away. Two samples are taken every week and submitted to the Borough Analyst for examination.

The first epidemic of cholera of which we have any data, occurred in 1832. From August to the end of October, about 500 persons are said to have died from that disease. At that time the town was in a most unsanitary condition. The graveyards were overcrowded, there was no proper system of drainage, or water supply, no collection of night soil or refuse, privies were built inside houses, and pigs allowed to live in cellars and garrets.

With such conditions existing it will be understood that little was done to prevent the spread of the disease, although I find "that the Guardians of the Poor not only sent chloride of lime to the houses of such poor persons as they knew to be in a dirty condition, but also sent women to ensure its proper application." This with free medicine and a day of fasting and humiliation seems to have been about all the precautions adopted.

The next epidemic lasted from June to October, 1849, when over 1,860 persons died. The distress was appalling, and the sanitary conditions were if possible worse than in 1832.

The chief source of water supply was the River Hull, which received above the intake the sewage of Beverley, a town of over 8,000 inhabitants, in addition to that of thirty or forty villages. The supply was intermittent, being restricted to two days a week. The town was grossly overcrowded; many streets were neither paved nor drained, and large accumulations of filth of the vilest character were allowed to remain in the most densely-populated parts of the town. No wonder then, that forty-one persons out of forty-three died from the disease out of a population of 81,000. In one week alone over 600 deaths took place.*

In 1892 the epidemic at Hamburg alarmed the people of this country, and in no place was the danger of importation greater than Hull, it being, from its geographical position, the port of transit for all Germany, as no less than twelve large steamers sail between the German ports and Hull every week.

The Sanitary Committee were alive to the situation, and at once adopted precautionary measures, every ship coming from German or Baltic ports being inspected by the Medical Officer of Health and Port Inspectors. A large number of men were employed to lime-wash courts, alleys, &c., systematic flushing of house drains was undertaken, and an inspection of each district was made by the members of the Sanitary Committee, which was continued until the end of November, when it was felt that the danger for that year was over; but two labourers were retained in each district to do such work as the Chief Inspector or District Inspector considered necessary. This was continued until July, 1893, when an epidemic of diarrhœa broke out, there being for the fortnight ending the 26th, forty-four deaths registered from that disease. Handbills of precautions were distributed to every house in the town, and eight extra men were engaged. This was the formation of the cholera column, which has been so highly commended by the entire medical press of the country. For sanitary purposes, the town is divided into four districts, and the column consisted of District Inspector, two Sanitary Officers, two Flushers, two Limewashers, and one Disinfector, furnished with a complete equipment of tools for their work. Arrangements were made so that the column could be assembled at a given point, within half-an-hour, and in several cases surprise calls were made, and every man drilled to his particular work.

---

* Sir Henry Cooper, in an address to the British Association, 1853: "According to a monument erected in the General Cemetery the number of deaths was over 2,000."

On August 16th a case of acute choleraic symptoms was notified by the parish doctor at a lodging house in Drypool. The case was isolated and precautions were taken to prevent any spread; but a few days later another case manifested itself in another lodging house about 100 yards distant from the first. The patient was removed to the Cholera Hospital and like the first recovered. Careful enquiries failed to establish any communication between the two cases. The next case was that of a boy, aged eleven years, who was seized on the morning of the 26th with purging, cramps, and vomiting: medical aid was called in but he died before being seen by the doctors. An inquest and post-mortem was ordered by the Coroner. Dr. Mason forwarded to the eminent bacteriologist, Dr. Klein, the stomach, bowels, and contents for examination; on the 28th that gentleman wired "suspicious case," on the 31st he wrote that he was of opinion that the case was one of "Cholera Asiatica." On September 1st another case broke out, which was also fatal, and bacteriological examination proved it also a case of cholera. This was followed two days later by a second fatal case in the same house, the victim being a daughter, aged 19 years, who had attended her mother. The duration of the attack was about 9 hours. As soon as death took place, I made arrangements for the removal of the body; this done, we fastened up the house. The following morning (Monday) we removed everything in the house to the Destructor, and destroyed it. After which we scraped the walls, and lime-washed them with hot lime-wash, to which had been added a strong solution of bichloride of mercury. The floors and all the woodwork were scrubbed by our men with hot water, and the bi-chloride in proportions of about 1 to 500. Two sisters of the case, who had come from Leeds to attend the mother's funeral, but who did not arrive until after the interment, were detained 4 days, and kept under supervision, and before they were allowed to return, were bathed, and their clothing disinfected. Their departure was notified by telegram to Dr. Cameron.

I may here give briefly the results of my observations of the disease. Almost every attack commenced between the hours of 11 p.m. and 2 a.m.; in some instances, purging commenced first, in others vomiting. The rice-water discharges are abundant, and give off little or no smell; in appearance, they are like a quantity of boiled rice in a colourless liquid, although in one instance the liquid was a rich pink colour.

The cramps are very prominent, the muscles of the legs and arms being drawn up as large as an egg; they come on at intervals of from 2 to 3 minutes, and continue about a minute. The arms and legs are very cold, the nails are blue, and become black. The voice is very feeble. About an hour before death the cramp ceases, the fingers and toes become clenched, the eyes glaze, the voice is gone, and life exhausted, passes away. After death *rigor mortis* quickly sets up, and soon passes away; and in some cases the body exudes a dark sticky fluid, and becomes almost black. In the last-mentioned case, about 20 minutes after death, the body moved, and one leg moved over 9 inches.

By September the 4th, our arrangements were complete, every case of diarrhœa was notified and paid for. For eight weeks the offices of the sanitary department were never closed, disinfectants and medicine were given away free of charge at the various Police and Fire stations, special mortuaries were erected at the eastern and western cemeteries. The "Ambulance" Staff was in telephonic communication with each Police Station. The total number of cases were, cholera 17, deaths 12; choleraic diarrhœa 137 cases and 4 deaths; simple diarrhœa 396 cases and 137 deaths, as against 6,300 cases 2,000 deaths in 1839. Never did Committee, Medical Officer of Health, and Chief Inspector work harder, never was any Executive better supported by the rank and file; every man did his duty with a zeal and earnestness which has earned the full approbation of the Local Government Board and of the Town. The total cost of the special precautions exceeded £2,000, as everything that had been in contact with a case was destroyed and replaced at the cost of the authority. The "Lancet" said: The vigour displayed dispels all doubt, disarms all resistance, and convinces the poorest and most ignorant that what is done is done for the best.

Dr. **Whiteside Hime** (Bradford) said he did not care to say anything to make people undervalue the importance of the efficacy of local arrangements when resisting cholera; but his experience up to the present time, and he thought that also of the writer of the paper, was to this effect, that cholera, besides the specific cause, had also secondary causes in spreading the epidemic, without which no amount of virus introduced into any locality would cause epidemic. Looking at the history of cholera in a general way all over Europe and the world, they found that although epidemic after epidemic occurred, a town which this year was ravaged with cholera, escaped the next epidemic. The personal susceptibility of individuals to cholera was also a thing which must be recognised, and he thought that towns might take courage from the fact that cholera was shown absolutely not to be infectious from person to person. He was in Hamburg during the frightful scourge two years ago, when in the space of six weeks something like 19,000 people were smitten down with cholera, and nearly 9,000 died. He was daily and nightly handling and in contact with cholera patients, but neither himself nor any of his colleagues who were there took cholera. Moreover, only about half-a-dozen of the numerous attendants were affected.

Mr. **Washington Lyon** (London), as the Chairman of a Cholera Committee at the time of the epidemic in 1867 and 1868, urged the importance of cleanliness. If they had cleanly houses, towns, and streets there would be no fear of cholera spreading in this country.

Mr. W. H. **Curtin** (Hull), in reply, said he wished to point out that in almost every case the houses were clean, and the districts healthy. Temporary mortuaries were erected at the cemeteries, and a special part of the grounds was appropriated for the interments, our own men acting as bearers. It did not matter at whatever hour of the day or night, they were always in a condition, within half an hour, to remove a case to the hospital, or body to the mortuary. The usual factors for the propagation of the disease are absent in Hull. The nature of the soil disposes of the ground-air theory, and the fact that the contamination of water is almost impossible, and that in the early cases at all events, the houses and persons were certainly not dirty; all tend to show that so far as the Hull outbreak is concerned previous experiences do not apply. Cases broke out in every part of the town, and the most careful inquiries failed to establish any connection between them.

A paper on "*The Preventive Measures for stamping out Tuberculosis*," *by* T. WHITESIDE HIME, M.D. (FELLOW), was read and discussed.

On "The Prevention of Mental and Nervous Diseases," by JAMES SHAW, M.D.

ABSTRACT.

CERTAIN exciting causes cannot be avoided, but the predisposing causes rendering them operative are to a great extent avoidable, or capable of having their effects minimised. Neurotic heredity is the most important, and in one sense the most preventable predisposing cause. Legislative measures against this cause to be deprecated. Best to rely on spread of knowledge, among the people, of the hereditary nature and interchangeability of these diseases. Offspring of paranoiacs, as indeed of all the degenerative insane, peculiarly liable to mental or nervous disease. Paranoiacs, like other degenerates, often recognisable by certain somatic stigmata (cranio-facial asymmetry, lobeless misshapen ears, cleft, vaulted, or high palate, &c.) long before the establishment of definite mental symptoms. (See article by author in "Medical Annual," 1894, on "Facial Expression," &c.)

Abuse of alcohol is another great predisposing cause, which is also often an exciting one. Its effects are not only direct but indirect (heredity, worry, pecuniary difficulties, accident, bodily disease, &c.) Of the three plans, prohibition, local option, and high licence, tried in America, for the diminution of the liquor traffic, the last of the three has been found to give the most satisfactory results. Alcohol should not, unless in great emergencies, be medicinally prescribed to persons of nervous temperament, or to young or middle-aged females.

Minor predisposing, and mostly eminently preventable, causes are faulty up-bringing or "spoiling," idleness, monotonous occupation, over-exertion, over-pressure in schools (especially where neurotic children are concerned), impure air, insufficient or unwholesome food (excessive tea-drinking

included), solitude, dull monotonous existence. Outdoor associated games to be encouraged.

Early prophylactic measures are necessary. In order to promote these the more important forewarnings of mental disease should be widely known, viz., sleeplessness, irritability, lassitude, loss of power of application, restlessness, anxiety, intense selfishness, affective changes, loss of interest in life, loss of self-control, moral lapses, facial alterations, and, most significant of all, change of character, the genial, liberal man becoming unsociable, mean, and selfish, and *vice versa.* Epilepsy, hysteria, hypochondriasis, neurasthenia, have also in many cases forewarnings, and the presence of the neurotic diathesis is, in a fair proportion of cases, marked by the existence, in a more or less modified form, of the somatic anomalies referred to in the first paragraph.

Change of air, scene, and surroundings (including separation from relatives) is the first indication, seldom now practicable, in the early or preventive treatment of most mental and nervous cases, and is only to be obtained in the majority of instances by the establishment of semi-charitable or wholly charitable institutions somewhat similar to the existing convalescent homes, but specially arranged for the treatment of these cases, allowing a maximum period of residence of at least six months, and affording opportunities for rest in some cases, for total change of occupation in others.

On "Sanitary Insurance," by G. WALTER STEEVES, B.A., M.D., M.O.H., Toxteth, Liverpool.

(MEMBER.)

ABSTRACT.

BY Sanitary Insurance is understood—A means for the protection of the public against insanitary dwellings or surroundings, and also a source for the supply of skilled advice on all questions of House Sanitation, in consideration of a fixed premium.

The definite objects to be—

1. To examine into the sanitary condition of any building previous to tenancy or after, and of affording skilled advice on

sanitary matters or appliances, either on existing premises, or on the plans of proposed arrangements of new buildings.

2. To issue certificates respecting the sanitary condition of dwelling houses and buildings.

3. To provide the means by which a cleanly and wholesome state of the sanitary arrangements of a house would be maintained.

4. The Sanitary Registration of dwellings.

5. The insurance of buildings against a defective sanitary condition.

Special notice of that class of property not usually suspected as insanitary, especially the rapidly erected property of the present day. Depreciation of such avoided by a system of regular and frequent inspection, followed by the correction of existing defects.

The existing Sanitary Associations to some extent useful—Their "protection" often dangerously misleading.

The *Mutual* principle of Sanitary Insurance—already tried, and carrying on successful work.

The educating effect of a properly established system of Sanitary Insurance.

The necessity of examining all houses *more than once in the same year.* Frequent inspections: Minor defects due to carelessness, etc., corrected at the outset—thus averting serious evils.

The building insured against an unsanitary condition, *i.e.*, any house having passed necessary test, and defects remedied, entitled to regular inspection and correction of sanitary errors—complete supervision—in consideration of fixed premium. Such risks not numerous.

A definite limit to the responsibilities of Sanitary Authorities.

Supplementary assistance of irresponsible societies of no permanent value.

Our present recognition of insanitary conditions through disease.

A consideration of our present conditions of life and intimate domestic relationships, established by a common water supply, sewerage system, milk supply, etc.

Means to be afforded the ratepayer of ascertaining *all those conditions* which surround him.

The value of a Register to insured members.

The advantages to builders—Insurance of entire streets of houses, resulting in individual protection.

On "*The Burial of the Dead,*" by C. H. COOPER, Assoc.M.Inst.C.E., A.R.C.Sc.I.

(MEMBER.)

Decomposition.

THE decomposition of organic matter in soil is effected by nitrifying organisms, which reconvert such organic matter into inorganic and thus complete the cycle of changes brought about in the substance assimilated by living beings. If the burial of the dead is to be continued without evil results, facilities must be afforded these nitrifying organisms to accomplish their important functions.

Nitrification.

The conditions that promote nitrification have for many years received considerable attention in most civilized countries. Although the organic matter dealt with has been for the most part that contained in sewage, yet the conditions that best promote nitrification in such a case will, with modifications, promote the resolution of the larger masses of organic matter dealt with in cemeteries. As nitrifying organisms require for their existence a sufficient supply of fresh air, any interference with such supply reduces their action, and if persisted in will allow putrefaction to set in which it is essential to avoid.

The soil in which the maximum nitrification takes place is coarse sand, the particles of which are as round as possible and of uniform size. It would be impossible to find any ground that would comply with these conditions, but the ground selected should be porous and contain as much Calcium as possible. If the level to which the subsoil water rises is not at a sufficient depth, the site should afford means of reducing such level to at least two feet below that to which graves may be dug, as nitrifying organisms practically cease work when submerged.

A diagram from the Minutes of Proceedings, Inst.C.E., Vol. CIX., page 247, was exhibited, which showed the average number of microbes and the amounts of nitrogen found at varying depths of certain sewage filters experimented upon by the Massachusetts State Board. This diagram gives 1,179,000 microbes as the average number found per gramme of sand in the first inch from the surface, 520,000 per gramme in the second inch, and 34,000 per gramme in the remaining fifty-eight inches which completed the depth of the filters. The average amount of nitrogen per 100,000 parts at similar depths being 110, 20, and 3·14, showing that by far the greater number of microbes and most nitrogen were found near the surface, from which it may be concluded that nitrification is most active near the surface.

Depth of Graves.

As bodies must have a sufficient layer of earth to effectually cover them, it is not practicable to place a body within two feet of the surface, but in no case should the depth of a grave exceed five feet. These depths refer only to suitable soil. The writer cannot define depths for clay ground, which in dry weather he has known to visibly crack to a depth of seven feet.

Coffins.

To prevent putrefaction it is essential that the earth, with its crop of nitrifying organisms, should come in contact with the body at as early a date as possible. Unfortunately our present system of burial prevents this taking place until long after putrefaction has in the majority of cases set in. Papier-mâché coffins were introduced with a view to expedite decomposition, but unfortunately such a substance as papier-mâché forms an air-tight covering for a considerable time, during which putrefaction is unchecked. If coffins are to be used, wicker or basket-work seems the only suitable material, and whatever other coverings are used should be as light and perishable as possible, and always allow air to pass freely through them.

Period required for dissolution.

The period required for dissolution of the body varies from a few months in the case of bodies placed in the chalk to at least thirty years for those placed in stiff clay. The flesh of the men and horses killed in the battle of Sedan, during the Franco-German war, and buried in chalk, had entirely disappeared after six months without leaving any unpleasent traces. An instance of the time required to decompose bodies buried in stiff London clay is afforded in the case of a portion of the Lambeth Cemetery, Tooting, which was first used in 1854–5 for the reception of those who died of cholera, and has since remained untouched. Immediately to the west of this portion is the Sewage Farm of the Croydon Rural Sanitary Authority, laid out in 1879–80, by Mr. W. Santo Crimp for Mr. Baldwin Latham, M.I.C.E. So impregnated was the ground contiguous to the cemetery with drainage oozing from the graves dug twenty-five years before, that the men excavating a trench close to the cemetery wall had at times to cease work and several were incapacitated for days. Nearly ten years later, in Feb. 1889, *i.e.* thirty-four years at least after the last bodies had been interred, the author, in company with Mr. Geo. Chatterton, M.I.C.E, took samples of matter oozing from the drains coming from the said portion, which were analysed by Dr. Dupré who declared them to be foul; a copy of the analysis is given on page 574.

About the same time the author took a sample of water that collected at the bottom of a newly dug grave ten feet in depth in a cemetery which is also situated on stiff clay. No interment had taken place to the head of this grave nor within ten feet from the foot. The graves on each side were occupied; one contained three children—an infant buried in 1884, and two children, aged six and four, buried in Nov. and Dec., 1887; in the grave on the other side an adult was buried in the latter part of 1887. There certainly was no overcrowding in this part of the cemetery, which was but little used, yet the sample of water collected was of the foulest description.

London cemeteries.

Let us consider the London cemeteries, where masses of putrefaction accumulate within the midst of the vast populations that inhabit the suburbs. The rule recognised by the Home Office Officials, although I believe it does not appear on any document, is that four adult corpses may be placed in each grave space of four yards in area (9 feet by 4 feet). If the average weight of each body be eight stone, an acre so utilized will contain 242 tons of putrefactive matter placed in the worst possible earth, and almost in the worst possible manner.

Two hundred and forty-two tons per acre is appalling, yet this in most of the London cemeteries is exceeded in ground used for ordinary interments. At the last annual meeting of the Church of England Funeral and Burial Reform Association, the case of a large cemetery in the East End of London was mentioned, in which the amount of putrefactive matter was quadrupled—sixteen adult corpses being placed in each grave, giving 968 tons per acre! That such a state of things is tolerated reflects serious discredit, not only on the official department charged with the control of cemeteries, but also on the sanitary authorities of the districts where such pest dens are allowed to exist and to be extended.

There appears little prospect of improving the nature of the soil of those cemeteries situated on clay, although clay can be rendered friable by the addition of house refuse, ashes, road sweepings, burnt clay, &c., but the expense and difficulties attending the adoption of such a method would be very great.

There is, so far as the writer can see, no satisfactory method except cremation by which the dead of certain large towns can be disposed of; and it is the duty of every sanitarian to endeavour to break down those prejudices that prevent cremation from coming into general use.

Law.

The law relating to burial, while it contains provisions as to consecration, ceremonies, constitution of burial boards, etc., hardly ever refers to the sanitary aspect of the question in the forty-one Burial and Burial Amendment Acts now in force; nor is there any regulation as to the number of bodies that may be placed in one grave. During the last forty years, legislation has practically done nothing to improve the sanitary condition of our cemeteries though the population of certain towns has increased enormously.

Each cemetery, so far as the writer is aware, has its own regulations, which have been approved by the Home Office; but like most governing bodies, those in charge of cemeteries consider they possess certain discretionary powers over their own regulations, although in point of fact, many of such regulations have been framed, as well as approved of, by the Home Office. As many cemeteries are in the hands of companies whose profits are increased by overcrowding, a state of things exists which is to be expected where profit seekers are left uncontrolled.

THE CEMETERY.

Site. Stiff clay ground, for reasons already given, should in no case be chosen for burial purposes; whatever site may be selected should be situated on light porous soil.

Drainage. The lower the level at which the subsoil water is situated below the surface the better, and as before stated in no case should such water rise to within two feet of the depth to which graves may be dug. The flow of subsoil and surface water from the site with respect to its liability to pollute water supplied for domestic use or for cattle should be most carefully considered.

In many cases irrigation plots or filters should be provided for the treatment of drainage from cemeteries.

Unfortunately cemetery authorities, especially where a profit is sought, have little or no interest in the sanitary welfare of the neighbourhood in which the cemetery is situated.

The Battersea Cemetery, situated in Morden, some seven miles from Battersea, is a case in point. The Battersea Burial Board, in order to overcome the opposition raised to their acquiring the site, provided land for filters adjacent to the cemetery and erected an engine and pump to raise the water that drained from the cemetery on to the proposed filters. Although the cemetery has now been in use more than four years the filters have not been constructed, so that the drainage from the graves dug in stiff clay goes direct into the Pyl and Beverley Brooks from which a large number of milch cows derive their supply.

Where it is desirable to treat the drainage from a cemetery, such treatment should be placed under the control of the Sanitary Authority of the district which is most affected.

Physical natures. Where other considerations are about equal, preference should be given to undulating ground, which affords facilities for draining off surface water and allows the surplus earth removed from graves to be used for filling in the hollows. A cemetery situated on undulating ground presents a far more pleasing appearance than if it were placed on flat ground.

Laying out.

The most economical method of laying out a cemetery is in rectangular sections with straight walks, but where picturesqueness is a desideratum it may be secured by adopting curved walks with varied shaped sections, which can be arranged to suit the contour of the ground, as is done with such good effect at Woking. Such a method, however, increases the length of paths and sacrifices a large amount of ground. Where curved paths cannot be adopted, the long lengths of carriage-ways and paths may be broken by placing clumps of trees at their intersections.

Ground required.

In growing districts it is well to secure ground sufficient for increase in population, and lay out only so much as is required for the next twenty years.

The proportion of ground that should be consecrated depends on the religious tenets of the district. In large towns the Roman Catholics, Society of Friends, and Jews have ground specially allotted to them.

The size of grave adopted by the Home Office, namely, 9 feet by 4 feet for adults, is less than that provided in most other countries. In the case of children's graves half this amount of ground is allowed, namely, 4½ feet by 4 feet, or 6 feet by 3 feet. The adoption of children's spaces complicate the working of a cemetery, and cause considerable irritation amongst adult relations who find they cannot be buried with their children.

The author does not purpose to treat of vaults, these he considers to be relics of those unsanitary conditions which imposed so much suffering and premature death during a period that is happily coming to a close.

The amount of ground in yards super required to provide graves for 1,000 persons may be found by multiplying the death-rate per 1,000 by 14 (the number of years which is allowed to elapse before re-opening a grave) by 4 yards (the area of a grave), thus with a death-rate of 24 we get 24 × 14 × 4 = 1,344 yards super, or about ·28 of an acre.

The amount of ground to be provided in a cemetery per 1,000 persons may be taken roughly as follows:—

	Acres.
For grave spaces	·30
„ walks and drives... ...	·07
„ plantations	·03
„ buildings, fences, &c. ...	·02
	·42, say half acre.

In the case of clay ground, or where the ground is not laid out in rectangular sections, the amount of land required will have to be increased.

Roads and walks.

The carriage-ways should not be less than 12 feet in width, and where not continuous, space should be provided in which to turn a funeral coach and horses. Sufficient carriage-ways should be provided to prevent the necessity for the bearing of a body more than 200 yards.

The walks ought to be at least six feet wide with a transverse fall not exceeding five-eighths of an inch to the foot. Both carriage ways and walks should have grass verges 12 inches wide on either side.

When paved paths are not provided, cinders generally form the most economical covering and save much labour, as weeds will not grow on cinders, but unfortunately cinders will not bear wheel traffic.

Division of ground.

Each plot containing graves is as a rule bounded by walks and carriage-ways, and forms what is termed a section. A convenient way of designating sections is by letters; thus, in the Wimbledon Cemetery, *A*, *B*, *C*, and *D* sections are in consecrated ground; *E*, *F*, and *G* in unconsecrated; while *H* is set apart for Roman Catholics.

In some cemeteries each section is allotted to a particular class of ground, whereas in others each section contains various classes, the graves next the walks being of a superior class to those nearer the centre. Thus, at Wimbledon, the row of graves next the walk is known as first class or (*a*) ground; the next row, or in some cases two rows, is second class or (*b*) ground; the central portion being third class or (*c*) ground. *B b* would thus denote second class ground in *B* section; *C a* first class ground in *C* section. If the ground is to the north of the section, *1* appears after the class letter; if to the east, *2*; to the south, *3*; to the west, *4*. *D*, *c 3*, would denote third class ground to the south of *D* section. Each class is thus numbered in four series, which shows at a glance almost the exact position of a grave without referring to a plan.

The working of a cemetery might well be simplified by adopting only two classes of ground: in the first of which grave spaces must be purchased, while purchase in the second class would be optional at half the cost of the former ground.

The allotment of certain ground for parish, or as they are sometimes termed pauper funerals, should be discontinued, as there is no necessity for such a distinction, which is painful to relatives. In Wimbledon no such distinction is made, nor does the superintendent know, when he receives an order for third class ground, whether it is for a parish funeral or not.

A considerable difficulty arises in setting out graves and in insuring that graves are dug in their proper spaces. Wood pegs soon decay, and if left projecting above ground they interfere with the cutting of the grass. Where possible, grave rows should be pegged out along the edge of the verges.

In laying out a cemetery, the width of a section should not exceed 110 feet, which allows of two one-foot verges, two rows of graves lengthways on either side, and eighteen rows in the centre, side by side. The length allowed to the sections may be varied to suit circumstances.

Buildings. Amongst the buildings to be provided in a cemetery, the MORTUARY is by far the most important. It should be placed in an accessible position well within view of all visitors. Shrubs and flowers should be planted about to give the mortuary a pleasing appearance, and to induce persons to send their deceased friends to it immediately after death.

The late Sir Edwin Chadwick, in his report of 1843, on "The Practice of Interments in Towns," gives case after case where deaths, many in succession, have resulted from the odious practice of using the same room as a mortuary and a dwelling. In many cases, *i.e.*, in one or two-roomed dwellings, the same chamber is used as a mortuary and a sleeping apartment, and perhaps occasionally food is prepared and consumed in the same room.

Even in a mortuary provided for a small community there should be two separate chambers, one of which is fitted with an operating table, &c., on which post-mortem examinations may be made; the other chamber should be fitted with slate shelves and shell coffins, for the reception of the dead only. In large districts a chamber should be provided for the remains of those who have died from infectious disease. The floor, walls and ceiling of each chamber should be rendered with Portland cement which may be coloured, so that the chamber can be washed down throughout and thoroughly disinfected. An ample supply of water should be laid on to each chamber and provision made for hot water in the post-mortem room. Cross ventilation should be provided in each chamber.

The superintendent's house is generally placed near the entrance, so that he can act as gate-keeper and also as mortuary attendant.

Fees. The custom of unnecessarily burdening persons who have had the misfortune to lose relatives seems to the writer most unjust. A cemetery ought, if possible, to pay its way, and those who perform services should be fairly paid; but unfortunately fees are often charged where no service is rendered.

If relations would only see that the remains of those belonging to them were disposed of in a sanitary manner, so as not to injure the health of the living, they would perform not only a duty of the highest respect to the departed, but also one tending to relieve suffering and premature death amongst those that remain.

No fee should be charged in respect of any mortuary.

TABLE OF ANALYSIS.

	From the part of Cemetery on clay little used. I.	From the Lambeth Cemetery. II.
Appearance	Turbid	Turbid.
Colour	Black	Milky.
Smell	Very offensive (H_2S)	No smell.
Deposit	Very much	Much.
	Grains per gallon.	
Oxygen absorbed from permanganate—		
In 4 hours	1·743	·329
In 4 minutes	1·05	·07
Total dry residue	53·2	233·8
Colour of residue	Yellowish-white.	
Behaviour on ignition.	Blackens very strongly, burns off with much difficulty.	Blackens very strongly, burns off with some difficulty, evolves nitrogenous smell.
Suspended matter	435·	56·0
Chlorine	4·76	4·62
Nitric acid	0·924	0·448
Ammonia	3·57	0·420

(Signed) A. DUPRÉ.

The Laboratory,
Westminster Hospital Medical School,
Caxton Street.

February 18*th*, 1889.

SECTION II.

ENGINEERING AND ARCHITECTURE.

PAPERS AND DISCUSSIONS.*

On "Water Supply," by PROFESSOR HENRY ROBINSON, M.Inst.C.E., F.G.S., F.S.I.

(FELLOW.)

IT is proposed in this paper to refer to a few points bearing on the question of water supply that are the outcome of recent observations of chemists and bacteriologists to whom engineers are indebted for clearing up difficulties which they have experienced in advising on this subject.

It has been contended by some that no stream should be utilized as a source of water-supply if it had been subject to the slightest sewage contamination above the point of intake, and that unless the stream was absolutely free from even the suspicion of sewage pollution it should be condemned as unfit to furnish a supply of water for dietetic purposes. It was formerly the custom to classify waters as "turbid," "slightly turbid," and "clear," and analyses of waters were made with a view to determining their purity entirely from a chemical standpoint. At the present time, however, a biological investigation is an essential part of the scrutiny that a water has to undergo. The "self-purifying" action of a stream is an important factor in effecting the destruction of pathogenic germs. If it were not for the natural purification which a river undergoes, the continuous discharge of even slight quantities of sewage or polluting matter into it would produce cumulative evils that would in time render every such stream an abomination. In writing on the subject of sewage disposal ten years ago the author stated :—"It has often been contended that organisms injurious to health derived from sewage decomposition, continue to live after their discharge into a river, and are practically incapable of being destroyed. Alarmists have relied on this in support of the contention that no river water is fit for dietetic purposes. I think this view has been overstrained. Is it not a reasonable assumption that these organisms may be quite incapable of existing when favouring conditions cease? This must be the case when, after they are cast into a river with the filth they thrive on, the whole becomes largely diluted, its temperature altered, and a state of things produced very different from that which previously existed." The recent enquiry about London water led to the expression of opinion that "When pathogenic bacteria pass into the outer air or water they are in an unnatural medium in which they can only maintain their existence and power of multiplication for a limited period during which they undergo more or less rapid attenuation or loss of virulence and become generally weakened."

The author is the last to under-estimate the importance of preserving water supplies in the purest possible condition, but he wishes to combat the merely sentimental part of the case, which at times may lead to the imposition of grave burdens on communities in regard to water-supply. In the application of the Rivers Pollution Prevention Act no efforts should be relaxed to prevent the streams from being employed as vehicles for carrying off sewage or manufacturing refuse. The standard of purity should be maintained high, and legislation, to preserve the purity of the streams, both from a sanitary and æsthetic point of view, should be made more compulsory.

Much information is now available in regard to the conditions under which the micro-organisms exist that are found in water, and the relation between the harmless and the harmful (or pathogenic) germs. Bacteriologists indicate that typhoid bacilli cease to have vitality in fœcal matter in fourteen days. However that may be, all agree that their capabilities of mischief and of multiplication are greatly lessened in a very few days.

Some of the chief causes of the destruction of these germs may be indicated briefly and generally. Low temperature is a factor adverse to their prolonged life, as they flourish in a higher temperature than that of river waters. Innumerable harmless bacteria which exist in rivers are found to be mortal enemies of the harmful bacteria. Light has an influence unfavourable to their existence, although the agency of light in destroying germs does not appear to be effectual at all depths. In shallow streams it is a more powerful factor in assisting their self-purifying action, than in deep sluggish rivers. Recorded experiments on cholera bacilli show that their virulence is greatly diminished by exposure to sunshine. Daylight without sun has also been proved to destroy them. The subsidence of suspended matter carries down germs which perish. Minute plants liberate oxygen under the influence of light, and assist this purifying action.

Bacteria appear to multiply more rapidly in pure water than in impure. In unboiled water they are found to multiply slightly, but in boiled water they multiply greatly. Miquel established this, and explained it as the action of a zymotic disease by which the water that originally contained bacteria was inoculated against them, whereas a pure water was not. The same result was arrived at by the experiments of the State Board of Health of Massachusetts, and by Dr. Percy Frankland. He found that pure moorland waters (which are regarded as unobjectionable sources) were very favourable to the cultivation of these organisms.

The storage of river water in impounding reservoirs is not attended with the certainty (as some considered) of the pathogenic germs flourishing and increasing, thus constituting a menace to the community supplied by it. The doubt of the safety of such waters is after all a matter of degree, as it is improbable that any source of supply is theoretically free from the possibility of pollution. Take the Thames water, which in past years has been supplied to London under far less favourable circumstances as regards pollution than now obtain: no outbreaks of disease have been traced to it.

Where there is a probability of contamination, and in order to reduce to a vanishing point the possibility of any pathogenic germs passing to the consumers, it is necessary to resort to filtration, and in judging whether filtration is requisite the engineer will be guided by the previous history of the water. A great amount of information on the effect of sand filtration is now available, notably the data published in the Massachusetts Report and also by Dr. Percy Frankland. It has been proved that efficient sand filtration will remove all but two or three per cent. of the micro-organisms, and this relates to the reduced number that have reached the filter after the destroying influences that have been referred to.

By constructing the filter so as to cultivate a nitrifying action there can be no question of the possibility of practically removing all germs. The best construction of a filter has to be considered in view of what it has to accomplish. If it has to remove finely divided suspended matter which is not suspected of organic pollution, very fine sand under most circumstances would serve the purpose. In one case which the author is acquainted with (namely the River Plate) this did not suffice, as the water contained a quantity of finely comminuted clay (giving the water a yellowish tint) which passed through the finest filter paper. A filter constructed of alternate layers of finely pulverized cinders and coarse sand was successful in arresting this matter. The efficiency of the filter was found to depend entirely on the fine cinders, even the absence of the dust caused a reduction of the efficiency. The experiments at Massachusetts established the fact that the chief bacteriological action takes place in the upper layer of filters. In the bottom inch there were but 3 per cent. of the number of bacteria that were present in the upper inch, and this has been found to be the case elsewhere. The conclusions drawn were, that with a five feet filter of coarse sand, ·06 of an inch in diameter, about 30 per cent. of the bacteria could pass through. With sand of ·006 inch diameter 14 per cent. passed. Very fine sand, 5 per cent. Garden soil none. Experiments on the filters of the London Companies indicate that the number of micro-organisms appear to be independent of the age of the filter bed. If the cultivation of the germs has been once established it will continue, provided the supply of organic matter and of air is continued and the rate of filtration is regulated. If too fast, the purification is imperfect, as the nitrification of the organic matter would be arrested for want of oxygen. The cleansing of a sand filter interferes with its action, as the surface film has the most useful effect, and forms an essential part of the filter by arresting and cultivating the micro-organisms which pursue their functions of nitrifying the organic matters retained in the filter. Many filters have been constructed for dealing with the purification of sewage by utilizing the action of micro-organisms, and they all point to a new departure in regard to the construction and the manipulation of filters in order to remove organic impurities. The subject is of so much interest and importance that it deserves the attention of all who are engaged in advising about water supply or sewage disposal.

[*For discussion on this paper see page* 596.]

On "*The Water Supply of the Borough of St. Helens, Lancashire, from Wells in the New Red Sandstone*," *by* Professor EDWARD HULL, F.R.S., F.G.S.

THE Borough of St. Helens, Lancashire, depends almost wholly upon deep wells sunk in the new red sandstone (Bunter), a formation which affords supplies to many large towns in England, amongst which may be specially mentioned Liverpool, Wirral, Manchester, Warrington, Nottingham and Birmingham. St. Helens is mainly built on the coal-formation at the western extremity of the great South Lancashire coal-field; but the new red sandstone and Permian formations * form the margin of the coal-measures to the south and west, and from these (particularly the former) the supplies of water are drawn for domestic and general purposes.

Having been connected with the borough of St. Helens for a good many years past in the capacity of Consulting Geologist I thought it might not be uninteresting to the members of this section of the Sanitary Congress if I were to give some account of the public wells of this borough; and upon applying to the Town Council for permission to do so I received their ready assent—for which I here tender my acknowledgments. It need scarcely be observed that the public wells of St. Helens have been put down, at successive intervals of time, to meet the requirements of increasing population and manufactures. The number of pumping stations has now reached five; while a provisional order has been recently obtained from the Local Government Board for the construction of a sixth pumping station, and is now being carried out.

In the selection of sites for these wells several considerations had to be attended to:—

First: it was necessary that the site in question should be in the new red sandstone where the thickness might be inferred (from the direction of the dip) to be considerable, and where there was a sufficient area of percolation—not less, if possible, than three to four square miles to each well.

Second: it was desirable that the sandstone should be in places near the surface; and particularly that it should not be overspread by a thick deposit of boulder clay, which is but slightly permeable or absolutely impervious, to the rainfall.

Third: it was necessary that each site should be at a considerable distance from any existing pumping station, either belonging to the Borough of St. Helens or some neighbouring borough. This was necessary, both in order to avoid opposition to a projected scheme, as also to avoid competition in pumping on the part of one well against the other.

The above were the chief physical and social considerations to be kept in view in the selection of each successive site for a pumping station; but besides these there were others of a local and economical character, all of which combined, necessarily tended to narrow the limits of selection.

---

* Except to a very limited extent the water from the wells is drawn from the new red sandstone alone.

I shall now proceed to give some details regarding each of the existing wells, which are arranged in order of construction in the following Table :—

Particulars regarding the Pumping Station.

Situation of Well.	Opened.	Yield at Date of Opening.	Present Yield.
		Galls. per day.	Galls. per day.
1. Eccleston Hill	1853	1,250,000	570,000
2. Whiston	1871	1,000,000	544.000
3. Collins Green	1878	900,000	630,000
4. Knowsley	1886	1,350,000	1,000,000
5. Kirkby	1891	1,500,000	1,500,000
6. Melling in course of construction) ...			
Total	......	6,000,000	4,244,000

I shall refer to these wells in order of construction.

1. *Eccleston Hill.*—This well is sunk on a promontary of new red sandstone, running northwards from the main area, and bounded by coal measures on the east and west sides; the boundary lines being faults. The position is 261·8 feet above ordnance datum, and from this position a service reservoir has been constructed to afford pressure for the supply of the town which lies at its foot. The area of supply being so limited it is remarkable that the permanent yield is as large as it is, amounting to 570,000 gallons per day. The depth of the well is 210 feet, at which depth the bottom of the new red sandstone was probably reached.

2. *Whiston.*—This well is situated about two miles south of the Eccleston Hill pumping station, and on the same promontary of new red sandstone. The strata dip towards the east, and are broken off by one of the faults previously referred to, along which the sandstone is brought into juxta position with the coal measures. The site is not, perhaps, the best possible, but owing to the opposition offered by the Borough of Widnes to one selected near Cronton, where the prospects were more favourable, this site had to be adopted as the only alternative then available. The selection was made on the following geological grounds: namely, that the water would tend to flow more or less along the planes of bedding towards the eastern fault, by which it would be impounded and thus form an underground reservoir. The yield was originally one million of gallons per day, but has fallen to an average of 670,000 gallons, and after

the extraordinary drought of 1883 to 544,000 gallons. The water is pumped up into the Eccleston Hill reservoir for distribution through the mains.

3. *Collins Green.*—This source is remarkable as the only one in which the sandstone of the Permian formation is utilized. During the sinking of the shafts for Collins Green Colliery large quantities of water were met in the Permian sandstone which there overlies the coal-measures. As the water was found to be pure, and was too valuable to be allowed to run to waste, the Corporation of St. Helens made proposals to the proprietors for the purchase of the water, which were accepted. The water is tubbed off the pits and is conveyed by pipes to the Borough, in order to augment the supply from the wells.

4. *Knowsley Well.*—About the year 1880 it became evident to the Corporation that the existing sources of supply were becoming insufficient for the increasing requirements of the borough. I was called in to advise as to the sites for additional wells, and in company with Mr. De Rance, of the Geological Survey, reported in favour of those at Knowsley and Kirkby, lying to the north and west of St. Helens. The formation is new red sandstone, the strata being nearly horizontal; and on examination we felt satisfied that the rock was saturated with water by observing the nearly uniform level of its surface in numerous quarries. We also found that the rock was close to the surface over a considerable area, or only concealed by a coating of drift-sand, from which we concluded that there must be large percolation. The Knowsley Well was commenced in November, 1882, and was accompanied by a second "pilot" well at a few yards to the northwards. These were sunk to a depth of 170 feet and yielded about 1,000,000 gallons per day. A bore-hole was then commenced from the bottom of the "pilot" well to a depth of 396 feet from the surface of the ground. This, however, had to be abandoned in consequence of an accident, and another well and bore-hole were put down, reaching a depth of 687 feet from the surface. The wells are connected by a drift-way 21 feet high and 6 feet wide, and the total yield was at first 1,500,000 gallons per day, principally obtained from a depth of 488 feet from the surface, but it has since fallen to 1,000,000 gallons which may be regarded as the permanent supply. The level of the ground is 140 feet above O. D., and that of the water on the completion of boring operations stood at 78 feet above O. D., or 62 feet from the surface. The whole of the rock penetrated is in new red sandstone of the division known as "The Pebble Beds," consisting of reddish brown sandstone with pebbles of quartz, jasper, &c.

5. *Kirkby Wells.*—These two wells are situated at a spot nearly two miles from the Knowsley Wells, and in similar rock. Each was sunk to a depth of 150 feet and connected by a drift way. They were commenced on 7th June, 1886, and completed on 5th May, 1887, and yielded about 950,000 gallons per twenty-four hours. A bore-hole was commenced on the 6th September, 1887, and reached a depth of about 450 feet, and water came in abundantly as operations proceeded.

The supply from this station has been most remarkable. The level of the surface of the ground is 100 feet above O. D. and the water in the wells 91 feet, or 9 feet from surface. On pumping for eighteen hours at the rate of 2,000,000 gallons for twenty-four hours, the level of the water could not be reduced lower than 43 feet from the surface, representing a column of 107 feet in the well. Mr. Gaskin, late Engineer to the Borough, to whom I am indebted for these details, made a series of experiments in December, 1887, from which he estimated that with a column in the well of 41 feet, the yield would be 4,000,000 gallons per twenty-four hours, at 66 feet, 3,400,000 gallons, 80 feet, 3,000,000, and so on. The present yield with the engine power employed is 1½ million gallons of water of very fine quality, but this is far short of the possible yield.

6. *Melling Station.*—Notwithstanding the large supplies from the above sources, the Corporation, with that forethought which is so commendable in a public body, considered it desirable to make further provision for the prospective requirements of the Borough, and in 1890 I was consulted regarding a site for an additional pumping station; I thereupon made an examination of the district still further to the west from Kirkby pumping station, and ultimately recommended a site at the village of Melling, not far from the position of a large fault which ranges N. and S. by the village. It was clear from the level of the water in the local wells (being only from 18 to 20 feet from the surface), and from the enormous quantity of stored-up water at Kirkby Well, two miles distant, that the sandstone is here thoroughly saturated below the water-level, and that we might anticipate a large supply. Nor were our expectations disappointed; for on putting down a 10-inch experimental bore-hole at the spot selected to a depth of 402 feet, the water was found to stand in a pipe at a height of 10 feet above the surface of the ground—a sure indication of a large supply. It is proposed to sink two wells to a depth of 150 feet each, and to put down a bore-hole of 11 inches diameter to a depth of 350 feet; in all 500 feet from the surface. I am confident that a large permanent supply may be anticipated from this pumping station. The

following is the analysis of a sample of the water from the bore-hole:[*]

Analysis of the Water from Melling.

1. Total solids in solution		35·5	grains per gallon.
2. Organic matter	Free ammonia	none	,, ,,
	Albuminoid	0·02	,, ,,
3. Combined chlorine		2·35	,, ,,
4. Hardness	Permanent 12·6 Temporary 5·7	18·3	,, ,,

Water "clear, colourless and tasteless."

Inferences to be gathered from the above facts.—I would now in concluding desire to offer a few observations on the practical deductions to be drawn from a consideration of the above facts:—

1. The experience derived from the supplies drawn from the St. Helens wells, as of other districts, is that the first supplies from these deep sources when newly tapped cannot be relied upon for continuance as regards quantity. When pumping operations first commence the quantity is larger than proves to be the case after the experience of a few years. The supply at first is at its maximum, because we are drawing on the large quantity of storage water with which the rock is saturated, and which must remain there until it is drawn off by artificial means. This original storage supply is independent of the yearly supply derived from percolation; so that at the first we have the advantage of a supply derived from two sources: that of original storage, and that from annual percolation. Ultimately, however, the former gives out if the pumping is sufficient, and then we have to depend on the annual percolation derived from the rainfall. This accounts for the fact that while the five existing wells yielded a total quantity of six millions of gallons every twenty-four hours when first started, this was ultimately reduced to four and a quarter millions of gallons as representing the permanent supply from these wells, as shown in the preceding table.[†]

2. As regards the water-bearing capacity of the sandstone, we may infer that it may be looked upon practically as a huge sponge, permeable in every direction and waterlogged in its

---

[*] For which as for other points I have to thank the Town Clerk, Mr. W. J. Jeeves.

[†] This is, however, only approximately correct, for, as Mr. Gaskin has pointed out, the supply from the Kirkby well might be increased by more powerful pumping machinery.

natural state. In all cases, however, there is an underground water-level which rises towards the interior and falls seawards. This level has to be reached before a supply can be obtained; and upon the continuance of pumping operations it is lowered from its original position. Where the Bunter sandstone is of great thickness, as it is in West Lancashire, the whole rock is probably water-bearing throughout, but the maximum supply seems to be derivable from a zone from 300—500 feet below the water-level.

3. Finally, in reference to quality, the water from the Bunter sandstone may be considered as pure, wholesome, and of a permanent temperature of about 60° Fahr. both in winter and summer—a quality in which it is superior to that derived from surface storage waters. The salts and carbonates of iron, lime, soda, and magnesia which it contains are not excessive, and are decidedly healthful for drinking purposes. The Borough of St. Helens must, therefore, be regarded as specially favoured in having in its immediate neighbourhood a source of water-supply so excellent as that afforded by the new red sandstone of South Lancashire.

This important point will be best illustrated by the analysis of the water from Knowsley and Kirkby wells furnished to me by Mr. Jeeves:—

Analysis of Water from the Knowsley Well.

1. Total solid in solution	... ...	22	grains per gallon.
2. Organic matter	Free ammonia...	0·002	„ „
	Albuminoid ...	0·018	„ „
3. Combined chlorine	... ...	2·50	„ „
4. Hardness	Permanent 12·12 Temporary 12·52	24·64	„ „

Water at first turbid, yellowish-brown; on standing for 12 hours it becomes clear. The colouring matter is due to iron.

Analysis of Water from the Kirkby Well.

1. Total solids in solution	... ...	20·8	grains per gallon.
2. Organic matter	Free ammonia...	0·002	„ „
	Albuminoid ...	0·018	„ „
3. Combined chlorine	... ...	1·70	„ „
4. Hardness	Permanent 12·20 Temporary 6·91	19·11	„ „

Water turbid, greyish-yellow: due to presence of iron; becomes clean on standing for some time.

The present Water Engineer of the Borough, Mr. J. J. L. Ackland, has favoured me with the following note:—

"(1.) Present levels of the water in Kirkby Wells indicate:

Gallons per day.	*Column in well.*
1,000,000	86 to 88 feet.
1,500,000	64 to 70 „

(2.) In July last the water in the bore-hole at Melling stood at 18 inches below the surface of the ground.

(3.) The water from Kirkby, as also from Collins Green, has been subjected to Clark's process for softening since the beginning of 1893."

[*For discussion on this paper see page* 596.]

On "*River Pollution*," *by* WILLIAM SPINKS, Assoc.M.Inst.C.E.

AT no time during the past thirty years has public opinion been so concentrated upon the serious condition of the rivers and streams in our manufacturing districts as at the present time, nor so nearly unanimous in its demands for the repression and entire abolition of the three great sources of pollution, viz.: the deposition of solids, the pollution by sewage, and trade effluents. As one who was born, and has lived all his life, almost upon the banks of the Mersey and its tributaries, I can claim to have much personal knowledge of the varying condition and quality of its waters, and have no hesitation in confirming the description of them "as a sort of cross between a sewer and an ash-pit."

HISTORICAL.

In 1865 a Royal Commission was appointed to inquire into the subject of the pollution of rivers, and their report relating to the rivers Aire and Calder was published in 1867. They found that:

"The rivers Aire and Calder and their tributaries are abused by passing into them hundreds of thousands of tons per annum of ashes, slag, and cinders, from steam boilers, furnaces, iron works, and domestic fires; by their being made the receptacle to a vast extent of broken pottery and worn-out utensils of metal, refuse brick from brickyards and old buildings, earth, lime, and clay from quarries and excavations, road scrapings, street sweepings, &c.; by spent dye woods and other solids in the treatment of worsteds and woollens; by hundreds of carcasses of animals, as cats, dogs, pigs, &c., which are allowed to float on the surface of the streams or putrify on their banks; and by the flowing in, to the amount of very many millions of gallons per day, of water poisoned, corrupted, and clogged by refuse from iron and chemical works, dyeing, scouring and fulling worsted and woollen stuffs, skin cleansing and tanning, slaughter-house garbage, and the sewage of towns and houses."

Again, the report says:

"Where the dye refuse is not discharged in sufficient quantity, that offensive matter deposited in the beds and banks of the streams becomes in dry weather putrid and stinking, and in floods is stirred up and floated forward to poison the navigable parts of the rivers and canals."

And again in 1869, reporting on the condition of the River Irwell they say, "that throughout almost the whole course of the various streams which here pass over the weir, not only has the water been polluted from both house and mill refuse, more or less in solution or suspension, but the river has been obviously made the recipient of furnace ashes, waste from spoil heaps of various kinds, and even earth removed from house foundations." It was perfectly obvious that after these reports the rivers could no longer continue to be used as tips and sewers, hence in 1876 was enacted the "Rivers Pollution Prevention Act," and as is now pretty generally admitted the good results that were expected to follow from its passing have failed to put in an appearance, except perhaps in purely residential districts, possibly because the persons upon whom the duty fell of putting the Act in operation were themselves the greatest offenders against its provisions; I refer of course to the sanitary authorities, nor could they therefore with a good grace urge reform upon the polluting trades, and so in default of a superior authority to bestir the offenders the law has been practically in abeyance in the manufacturing districts. I will cite one single instance in support of this statement.

Dr. Arthur Whitelegge, the Medical Officer of Health to the West Riding of Yorkshire County Council, in reporting in 1891 upon the condition of the River Tame (one of the tributaries of the Mersey) as it flows through the Saddleworth district of Yorkshire, said "Where houses are situated at a distance from any stream it has generally been found more convenient to turn the drainage upon the land, but with these exceptions the river forms the common sewer for all purposes; and as already stated much of the pure water has been diverted from it. Every village and hamlet along the course of the stream contributes to the pollution, and though some lengths of pipe drain have been laid the prevailing system in all is an irregular arrangement of rubble drains and sewers leading invariably to the water courses, and without any attempt at purification of the sewage several ashpits and privies adjoin the stream, and some discharge directly into it and others make a special provision for flushing when the river is in flood."

A very similar if not worse state of things was found to prevail on the river Tees by Dr. Barry in 1891, at Barnard Castle, and in his report to the Local Government Board will be found a number of excellent photographs depicting these offences. Such then was the condition of things at a period of fifteen years after the passing of the "Rivers Pollution Prevention Act."

LEGISLATION.

In 1888 was enacted the Local Government Act as applied to counties, and Section 14 of that Act confers powers upon the County Councils to enforce the provisions of the Rivers Pollution Prevention Act, 1876, and Sub-section 3 of the same Section further confers powers upon the Local Government Board to constitute joint committees from the County Council of the watersheds of particular rivers, and confer upon them all the powers of a Sanitary Authority. Thus after a lapse of twelve years have we an efficient and impartial authority, to see that the law is administered against all offenders alike, whether they be sanitary authorities or traders, but it cannot be too clearly understood that the duties of such an authority are purely ministerial and that they are in fact "Sanitary Police." I often hear it stated by members of Local Boards that the County Council or Joint Committee should take in hand the design and construction of sewage disposal works; they possess no such power nor can they provide money for the purpose, and the duty of their officers is to find fault, but not to make any recommendations. Under the powers referred to, the Mersey and Irwell Joint Committee was formed in 1891, and quite recently a similar Board has been formed for dealing with the whole of the rivers in the West Riding of Yorkshire. Recent experience in the administration of the Rivers Pollution Prevention Act, 1876, has shown that it was not possible to obtain by its agency alone all that was necessary, and in 1893 an important amendment was passed in explanation of Section 3, which reads as follows: —

"Where any sewage matter falls or flows or is carried into any stream after passing through or along a channel which is vested in a sanitary authority, the sanitary authority shall, for the purposes of Section 3 of the Rivers Pollution Prevention Act, 1876, be deemed to knowingly permit the sewage matter so to fall, flow, or be carried."

And again with reference to solid matters, we find in the Public Health Amendment Act, 1890, Part III., Section 47, as follows:—

"It shall not be lawful for any person to throw or place, or suffer to be thrown or placed into or in any river, stream, or water-course, within any district in which this part of this Act is adopted, any cinders, ashes, bricks, stone, rubbish, dust, filth, or other matter which is likely to cause annoyance."

But unfortunately this Section can only be operative where this portion of the Act has been adopted, the Act being permissive.

The Mersey and Irwell Joint Committee had not been in existence very long before it was found that the procedure under the Rivers Pollution Prevention Act, 1876, was so lax that it was almost hopeless to expect any material improvement to take place in the condition of the rivers within a reasonable time, consequently in 1892 an Act was obtained entitled:—

"An Act to make more effectual provision for Prevention of the Pollution of the Rivers Mersey and Irwell and their tributaries."

PART I.

It will be seen that this part is considerably in advance of the general law and that there is sufficient protection for manufacturers when engaged in cleansing out lodges or reservoirs, &c.

PART II.

It will be seen that the most important provision in this part is the power conferred upon the Joint Committee to fix a specific time within which sewage disposal works shall be undertaken, and also to extend such times if in their judgment the circumstances so warrant it.

PART III.

It will be noticed that this part of the Act introduces an entirely new form of procedure in the shape of consent to proceedings being taken against the offender having to be obtained from the Local Government Board after they in certain cases have held an inquiry.

SECTION 10.

This Section it will be observed is of great value if really serious work is to be accomplished, and although at first strenuous opposition was offered to its enactment, there has I understand been little or no friction in carrying it out in the Mersey or Irwell District.

During the past Session of Parliament the Conservancy Board for the West Riding of Yorkshire have obtained an almost similar Act, and during its progress through both houses the County Boroughs took strong exception to this power of entry and also to the procedure and asked for concurrent powers, but in neither house did they meet with any sympathy, it being pointed out that they would all have their proper proportion of representation on the Conservancy Board.

POLLUTION FROM SEWAGE.

Happily this once chief source of pollution is being gradually lessened by the completion of Sewage Disposal Works and systems of sewerage to intercept all existing outlets into streams. It is not the occasion now to discuss the vexed question of sewage disposal, but if we are to have our rivers in a satisfactory condition, not only must the sewage be clarified, but it must be purified in such a way that secondary decomposition will not ensue after the effluent water has been passed into the streams, and, further, the night sewage, as is often done, must not be discharged through a bye-pass in its polluting state, it should either be stored in a tank or reservoir sewer until work is resumed, or else the works should be kept in operation during the night.

Unfortunately, most of our towns in the manufacturing districts have very few water-closets, in fact, from inquiries I made a few years ago, I found they did not average more than 3 °/₀ of the whole, and that where the dry closet systems prevail there seems to be an opinion that there is no necessity for the construction of sewage disposal works as it is alleged that the sewage is only sink water and can, therefore, contain only a little of soapy and greasy impurities. Sewage is a very complex liquid, and even in towns such as these will contain, in addition to the sink water, nearly the whole of the urine (mostly from chamber slops), the drainage of stables, cow-houses, and slaughter-houses, middens, &c., &c., and it was found by the Royal Commission on Rivers Pollution in 1868 that the difference in degrees of impurity between a water-closeted town and non-water-closeted town was very slight, as will be seen by reference to the well-known table here quoted :—

Table I.—Average Composition of Sewage.

In Parts per 100,000.

Description.	Total Solid Matters in Solution.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Total Combined Nitrogen.	Chlorine.	Suspended Matters.		
							Mineral	Organic	Total
Midden Towns	82·4	4·181	1·975	5·435	6·451	11·54	17·81	21·30	39·11
Water - Closet Towns	72·2	4·696	2·205	6·703	7·728	10·66	24·18	20·51	44·69
In Grains per Gallon.									
Midden Towns	57·68	2·926	1·382	3·804	4·515	8·078	12·467	14·910	27·377
Water - Closet Towns	50·54	3·287	1·543	4·692	5·410	7·462	16·926	14·357	31·283

In many sewage disposal works, especially those of small towns, very imperfect means are employed in the treatment of sludge, and I have frequently seen it thrown upon the ground to dry in the atmosphere, and the liquor, which as is well known is more foul than the crude sewage itself, draining directly into the stream. Wherever the sludge is not pressed it should at least be placed on an impervious surface, such as concrete, and the liquor either drained back into the tanks for re-treatment or be treated separately.

It is not possible to carry out in every town the separate system of sewerage, but it is frequently attempted in a partial manner, that is to say, old sewers and water-courses are utilised for carrying off the surface water, and where this is the case great attention should be paid to the scavenging and condition of the carriage-ways. Since the substitution of impervious carriage-ways, pavements, and tar macadam for the ordinary macadam, a very great improvement has been effected, still the surfaces should be cleansed very much more frequently, certainly oftener than once a week, as is the economical habit of many small towns. I know it is not feasible for them to have a system of orderly bins as in London and many large towns, but a daily sweeping at least is necessary in all streets of busy traffic. Again, the gullies require more frequent cleansing, and the deposited silt, &c., removed. On the grounds of health alone it is very undesirable to have these cesspits, with their putrifying contents, be they large or small, adjacent to houses, and more especially is this so in the narrow streets and courts of our large towns.

TRADE EFFLUENT.

In considering the pollution caused by manufacturers' refuse it will be more convenient not to follow the order of the Acts of Parliament, but to refer to the solid and liquid refuse as if they were one, because the pollution caused by tipping of cinders and other refuse has now been practically reduced to a minimum, but there remains an immense quantity of solid refuse which is carried into streams in a state of suspension.

I do not propose either to discuss any particular method of preventing pollution from each process of manufacture as no common system can be applied, each must be considered accord-to such circumstances as position relative to the stream, riparian rights, the quality of the wastes, and other conditions. It is well known that most works have been so laid out that the last process in manufacture takes place as near to the water's edge as possible, hence the difficulty of selecting a site for purifying works to which the liquor from the different waste pipes can be delivered by gravitation. Thus in most cases pumping has to be resorted to, as long as this is so the question of the method of treatment becomes simplified, as it is then only a question of the purchase of a sufficient area of land for the purpose. In closely built areas in towns the land question is of course a great difficulty which can only be surmounted by the adoption of a process that will take up little space. Precipitation is in nearly all cases absolutely necessary, assisted by some agent adjusted so as to do its work in as little time as possible; the tanks for this purpose may be where land is obtainable of the long and shallow type and where land is not readily obtainable then of the deep vertical type. In many manufactures good work may be done by preliminary straining through copper wire strainers of small mesh, indeed, in many instances this is all that is necessary, while in other cases after the effluent has left the tanks it will often require filtration in addition. Care must also be taken to see that the liquor from the sludge does not find its way into the streams. I am not a chemist so do not offer any opinion as to what may be done with the sludge; there may be untold wealth in some of it provided the process of recovery is cheap and there is a ready and convenient market for the product. Many manufacturers have been indisposed to attempt the solution of this question for themselves, and attempts have been made and in some instances successfully, to induce the local authority to take all trade effluents into the system of sewers and deal with them, combined with the domestic sewage. Section 7 of the Rivers Pollution Act, 1876 reads as follows:—

7. "Every sanitary or local authority having sewers under their control, shall give facilities for enabling manufacturers within their districts to carry the liquid proceeding from their factories or manufacturing processes into such sewers.

"Provided that this Section shall not extend to compel any sanitary or other local authority to admit into their sewers any liquid which would prejudicially affect such sewers, or the disposal by sole application to land or otherwise on the sewage matter conveyed along such sewers, or which would from its temperature or otherwise be injurious in a sanitary point of view.

"Provided also that no sanitary authority shall be required to give such facilities as aforesaid where the sewers of such authority are only sufficient for requirements of their district, nor where such facilities would interfere with any order of any court of competent jurisdiction respecting the sewage of such authority."

There is a great deal of uncertainty about the true interpretation of this Section, nor has any attempt yet been made to obtain one from the Courts. There are many difficulties in the way of admitting trade effluents into public sewers; in very many instances the water used in the process of manufacture is drawn directly from the stream, and is therefore bound after use to be returned to the stream. To illustrate the risk that an authority would run in taking an effluent, let us assume that the last place from which a connection is made is situated upon the stream at least half a mile above the sewage disposal works. All would be well until an additional works was erected nearer to them; then the newcomer would at once say: "You are abstracting from the stream, and carrying past me, water to which I am entitled, and so that I may enjoy my full rights it must be returned so as to flow past me." I venture to think it does not require a legal mind to foretell what difficulties may ensue in such a case.

Again, how is it possible to determine the size of the sewers where trade effluents are taken in? As an engineer engaged in the designing of sewerage schemes, I find that hardly any manufacturers, except those on a small scale, can ascertain how much water they use, and certainly not the maximum quantity of any given period of the day, as the supply is often from private sources, in addition to what may pass through a meter; but assuming all this could be done to a nicety, how is it possible to make provision for future increase or extension? Again, in the treatment of the sewage at the works the precipitant at a particular time may be nicely adjusted to deal with the quantity of sewage flowing in, when someone may take it into his head to let off a number of vats or tanks, thus not only increasing the volume of flow but also changing entirely the chemical composition of the sewage and in such a way as to render the efficiency of the precipitating agent nugatory. The sludge question—quite difficult enough of solution even when it is solely the residue of domestic sewage, without the addition of that brought down by trade effluents—would then be intensified tenfold.

This is hardly the occasion to discuss the extremely delicate point in Municipal Ethics, as to whether the manufacturer should have his effluent conveyed along the public sewer and dealt with at the expense of the rates, or, failing this, should be relieved of any contribution towards the expenses of such sewage schemes. Quite recently, Mr. Malcolm Paterson, C.E., of Bradford, proposed in designing a sewerage scheme for Elland on the River Calder, to provide in addition to the sewage of 10,000 persons, for a further 500,000 gallons per day from the manufacturers.

After the Inquiry had been held by the Local Government Board Inspector, the following letter was in due course received from them by the Local Board.

LOCAL GOVERNMENT BOARD.
28th June, 1894.

SIR,

With regard to the proposed works of sewerage and sewage disposal, the Board observes that in addition to the ordinary domestic sewage, estimated at twenty gallons per head of the population, it is proposed to receive into the sewers trade refuse from manufactories, estimated at fifty gallons per head. The board are advised, however, by their chief engineering inspector that this course is very undesirable, as the reception into their sewers of such large quantities of refuse, the character of which will vary from hour to hour according to the number of factories which are discharging their refuse at any time, will render almost impossible the proper purification of the sewage at the outfall, and the treatment which may be successful for this purpose at one time may utterly fail at another. The Board would therefore suggest that the Local Board should consider the desirability of taking steps to prevent the discharge of unpurified trade refuse into the sewers.

I am, Sir, your obedient servant,
C. N. DALTON, Assistant Secretary.

SELF-PURIFYING POWER OF RIVERS.

There are many small agricultural towns in England situated upon the banks of rivers of considerable width, and having a fairly constant velocity and volume during all periods of the year, and investigations have shown that a few miles below the outlet of the sewers there is little or no trace of pollution, consequently the Sanitary Authorities of such towns have felt it to be a hardship to be called upon to carry out costly schemes of sewage disposal, especially when it is remembered that in towns of that character the rateable value is on the decline. But in the present state of our knowledge as to the self-purifying powers of rivers it is difficult to see where any line could be drawn. The subject has been extensively discussed of late years, notably by Dr. Frankland at the International Congress of Hygiene held in London in 1891,* and again by Mr. H. A. Roechling, A.M.I.C.E., at the annual meeting of the Incorporated Association of Municipal and County Engineers, held at Bury in 1891.†

Dr. Frankland is of opinion that "sedimentation is the main cause of any self-purification in river water. Of any rapid oxidation of dissolved organic matter there is still no reliable evidence, although of course dilution which frequently takes place on the larger scale, as in the case of the Thames, without being suspected until made the subject of a most careful scrutiny will produce a superficial appearance of such a result."

Mr. Roechling lays great stress on the investigations by Pettenkofer on the river Isar at Munich, where the velocity is 4 feet per second and the discharge 1400 cubic feet, the raw sewage amounts to 40 cubic feet or 2·5 per cent., and Pettenkofer is sanguine that in this case no pollution will ensue, and he is also of opinion that if the sewage never amounts to more than $\frac{1}{15}$ or 6·7 per cent. of the river water, and the velocity of the latter is at least equal to that of the former, the raw sewage may be poured into such river without causing pollution. In America Mr. J. P. Stearns, the engineer to the Massachusetts State Board of Health, has also investigated the same questions, and his conclusions are that if the sewage amounts to more than $\frac{1}{40}$ or 2·5 per cent. of the quantity of river water it cannot be discharged into the river in its raw state; if it amounts to less than $\frac{1}{40}$ or 2·5 per cent. and more than $\frac{1}{130}$ or 0·8 per cent., it is doubtful whether it may be admitted; but when the sewage amounts to less than $\frac{1}{130}$ or 0·8 per cent. of the river water then, without any doubt, it may be admitted in its raw state into the river. Stearns adds that these considerations are made from the "standpoint of the offensiveness of the water." These conclusions have not yet been accepted as final by English authorities, and so there is no relaxation in the administering of the Rivers Pollution Prevention Act, and especially should this be the case where river water is abstracted for dietetic purposes. The condition of things in the Tees Valley in 1890—1, as disclosed by the report of Dr. Barry to the Local Government Board, issued August, 1893,* seems hardly credible, so filthy was the state of the river about Barnard Castle and above the intakes of the Waterworks. At the particular times referred to in the report there were two very serious outbreaks of enteric fever amongst a population of 500,000 persons; there was nothing in the general sanitary conditions of the urban or rural districts to account for such abnormal outbreaks, but when the water supply was investigated, it was found that not only the sewage but a great proportion of solid filth, from 10,000 persons, was poured directly into the river without any pretence at concealment, and in times of flood this was carried down to and past the intakes of the waterworks, and while the epidemic lasted the death-rate from enteric fever per 10,000 of the population was, amongst users of the Tees water 10·3, and for non-users 2·1.

---

* Transactions of the Seventh International Congress of Hygiene and Demography, Vol. vii., p. 70.

† Proceedings of the Incorporated Association of Municipal and County Engineers, Vol. xviii., p. 336.

Dr. Barry's report is copiously illustrated with maps, tables, diagrams, and photographs, and is well worthy of study by all interested in this question.

SUGGESTED IMPROVEMENTS.

The narrow streams which pass through our towns and manufacturing districts instead of being purifying agents and a blessing are unfortunately the very reverse, and it is to be feared their loathsome poisonous waters, if not directly the source of disease, serve to maintain a low condition of vitality in those dwelling, or having occupation, upon their banks.

Our sanitary authorities can do a very great deal to improve their condition besides purifying the sewage. In many of the rivers flowing off both sides of the Pennine Range there are in the beds a great number of pieces of rock, of all sizes and irregular shapes, and during periods of diminished flow the sides of these are covered with a nasty filthy slime due to the sedimentation.

---

* Twentieth Annual Report of the Local Government Board, 1891—2, Supplement.

This putrifying fœtid filth is a standing danger to health, and in every well managed town should be removed, as thus the scour and flow of the channel would be greatly improved. Again, the plan which has been adopted in some towns of paving the bed of the streams and forming an inverted channel for the dry weather flow is an excellent one, it prevents sedimentation in the least desirable places, and also presents outside the channel a clean dry surface at all times.

In course of time when our rivers have become clean, a greater value will be set upon the water, and possibly the question of Conservancy may be again revived, for there are many uses to which the water may be put, such as watering streets, the flushing of sewers, and (after filtration) for open-air baths, to say nothing of a variety of commercial purposes.

The recent opening of the Manchester Ship Canal, has quickened public opinion on this particular subject; to some it has appealed in a two-fold sense, as sufferers from the nuisances, and as shareholders in the Company, by the constant drain upon the revenue caused by dredging the solids brought into the Canal.

It is quite clear, from the support accorded to the endeavours of the Mersey and Irwell Joint Committee, by public opinion, as voiced by the press, that the populace waits anxiously for the time when our rivers shall be restored, if not to the condition of their pristine state, at any rate to a condition which shall in its quality satisfy the most exacting sanitarian, and in colour be no longer an offence to the least æsthetic amongst us, so that instead of being a plague and constant danger to health, by day and night, the river, when rescued from the degrading uses to which it has been allowed to be put by the indifference of some, the ignorance of others, and the neglect of many, shall be a sweetener of an atmosphere which, from other sources, is sadly too polluted.

[*This discussion applies to the papers by* PROFESSOR H. ROBINSON, PROFESSOR E. HULL, *and* MR. W. SPINKS.]

The PRESIDENT of the Section (Mr. G. F. Deacon) said that he thought that Professor Hull had made the remark with regard to his (the President's) views as to a proper source of water supply, under a misapprehension. He had referred to pure mountain water taken virtually from above the limits of human habitation, and he had added the words, "or drawn from perfectly safe sources underground;" so that in expressing his views, he did not by any means exclude well supplies.

Sir **Charles Cameron** (Dublin) said he would like to make a few observations. First he would point out that he did not think that since the subject of the qualities of water had been considered, the question had ever been in a more unsatisfactory condition than it was at the present moment. He quite agreed with the statement which had been made, that the question of water supply, or the purification of it, which had been thought to be settled, would be completely reversed, perhaps in a year or two afterwards. He wished to point out how very unsatisfactory was the state of this question, especially as to the condition in which water might be allowed to be, and yet be considered to be sufficiently pure to be made use of for potable purposes. Chemists maintained that if water contained a certain amount of albuminoid organic matter, it was unsuitable for use. They allowed so much albuminoid ammonia in pure water; in fact, a quantity which was certainly smaller than Professor Hull had advocated. Then chemists came down to waters containing a moderate quantity, namely, ·001 of a grain of albuminoid ammonia. Then they graded down to the very impure kinds of water, containing 0·1 grain, and more of albuminoid matter. Then the bacteriologists came in and said that the amount of albuminoid, or any other organic matter in water was not so important as the number of micro-organisms which the water contained. And then it was said that if water contained, say 25 micro-organisms per cubic centimetre, it was the best quality, and might be safely drunk. Another class of bacteriologists said that it was not of the slightest consequence what number of organisms there were in the water, the question being what was their nature, because the organisms might be perfectly innocuous. If this were true, an examination of the water, say in a small village or in a private house, would become a most expensive operation; inasmuch as it would require a man, like Dr. Klein, or Dr. Crookshank, or Dr. Frankland, to differentiate these organisms, and point out which of these properties were virulent, and which were harmless. It appeared, also, that the amount of organic matter that was considered sufficient to condemn the water was exceedingly small. With regard to the filtration of water, it was in a most unsatisfactory condition, notwithstanding all the labours of the Pollution Commission. One set of men said that they did not care about the chemical analysis of water, or about the bacteriological examination either; what they wanted to know was the pedigree of the water. He might say, that it was not a Welshman who said it, although all Welshmen were great upon pedigrees. The water supply of Hamburg during the recent terrible epidemic of cholera in that city, was also used in Altona; but after it had received the sewage of Hamburg, with its 800,000 inhabitants, and yet there was very little cholera in the latter place; while in Hamburg, there was an enormous death-rate from it. The water used in Altona was filtered, and it was taken from the river Elbe, the inference being that it was the filtration of the water which rendered it so healthy. They were told that the pedigree of water was everything, and now could there be a worse pedigree than that? His impression was that the enormous amount of mortality caused by cholera at Hamburg was due to causes quite apart from the water supply—namely, to the extremely unhygienic conditions in which a large portion of the city was. He agreed that it was far better to use water which required no purification, than water that had been polluted and had been purified. The question was, did the purification through sand remove all that was objectionable. He thought the number of bacteria might be reduced to a small percentage indeed; but were they at the present moment in a condition in which they could safely say that the portion of organic matter in water that could not be removed by filtration was innocuous? He maintained they were not in that condition. It had been proved that many of the worst diseases attributed to bacteria were produced by secondary agents. It was not bacteria alone that produced lowered vital conditions, but certain soluble organic matter created by the influence of microbes. The microbes themselves were in many cases poisons, but, being insoluble, no doubt they could be filtered out; and he believed that they were safe to a great extent, by filtration, from such diseases as required to be produced by the direct action of the microbes, if the filtration was perfectly carried out and conducted in the way in which it had been shown (especially by Professor Frankland) it ought to be.

Mr. C. H. COOPER (Wimbledon), alluding to trade refuse, said it occurred to him that the trade of this country would be very materially interfered with if manufacturers were compelled to treat all their liquid refuse. Take the case of a village with one large manufactory on which the village depends for its support. The Local Authority might at a small additional cost treat the refuse from such manufactory, whereas, the cost to the manufacturer might be so much that his manufactory would no longer pay him, in which case he would close his doors or move to another district, so that the staple trade of the district would be ruined. He had himself advised the Maybole Authorities some four years ago as regards their sewage treatment. The staple trade of the town was boot making, for which three or four tanneries existed right in the centre of the town. There was no ground near on which the tanneries could treat their liquor. At the time the Police Commissioners had under consideration whether or not they would compel these manufacturers to treat their refuse. But under his advice all trade refuse was admitted into the sewers, with the result that little or no additional cost has been incurred in sewage treatment. He thought it would be a great deal better for the authorities in the places alluded to by the author to try as far as possible to treat the refuse from their factories. As regards a separate system, he was certainly very much surprised to hear Mr. Deacon and Mr. Spinks both advocate it. He had the misfortune to have the system in his district, and all he could say was that during dry weather, such as occurred last summer for instance, when there was very little rain the street washing which ran into the surface water sewers was far fouler and gave off far more unpleasant smells than the raw sewage that passed through their sewers. He had had an analysis made of street washings, and it showed that these washings were far more impure than sewage. Instead of surface water sewers storm overflows form a much more sanitary and less expensive means of dealing with storm water. He should like to know with regard to Professor Hull's paper if a hydro-geological survey was made, or if the amount of catchment area of the wells was estimated; also, if cognisance was taken of any foul water which must have entered the sandstone. When carrying out the main drainage of Aston and Handsworth, the water in the trenches sunk in the new red sandstone was very foul; the houses on each side of the roads had privies situated about sixty feet from the trenches.

Mr. CHARLES BURT (Richmond) said he happened to be a member of the Thames Conservancy Board, and during last Session a very important Bill was brought in by them and ultimately carried. Having been Chairman of the Board's Parliamentary Committee he had to give considerable attention to it. The great object was to preserve the purity of the River Thames, primarily no doubt for the purpose of supplying water to London. According to the old law, made twenty-seven years ago, twelve months' notice was given to riparian local authorities to cease pouring their sewage into the river, and in one particular case he knew that litigation on this subject continued for a period of twenty years. It was not until that period had expired that the particular town he was speaking of actually stopped the flow of its sewage into the Thames. The new Act shortens the period of notice to three months, and makes it much more effective than the old law. It was laid down in the Act that neither sewage nor any other offensive or injurious matter should be allowed to pass into the river. Of course if this principle were to be applied to the rivers in the neighbourhood of Liverpool, and especially to the streams that discharged into the Manchester Ship Canal, there would be a very great difficulty in giving effect to it; but all the same the principle laid down was a right and proper one. He did not know what was to be done with the state of the Ship Canal, but he was afraid that many rivers in the neighbourhood were in a similar condition. He thought that every effort ought to be made to exclude offensive matter from every river and stream in the country. With regard to the Thames, the distance over which the powers of the Conservancy Board formerly extended was ten miles from the river, but now their powers extended up the whole length of every river and stream falling into it; in some cases going up twenty or twenty-five miles, in fact the whole water-shed. There was a tremendous opposition to the Bill, one hundred petitions being presented and thirty days spent in the House of Commons Committee examining every line; almost every paragraph in the Bill; everything was contested; but thanks to the firmness and vigour of the Chairman (Mr. Jackson, one of the members for Leeds) and the other members of the Committee, the Bill was passed through, practically unscathed as regards the provisions against pollution. With regard to the Rivers Pollution Act, he thought it would be found that it was very imperfect indeed, and left too much in the hands of those who were interested in allowing the pollution to continue. If they permitted the local authorities, whose members and constituents were interested, to continue to foul the rivers, it would be centuries before they succeeded in getting them pure. Therefore he urged that wherever practicable they should have a Joint Committee—say of the County Councils or Special Conservancy Commissioners, not drawn from the persons who were interested in continuing the pollution—to carry out the Act. In his opinion it should not be left in the hands of the local authorities from whose towns the pollution came. There was a great struggle on the part of many of the local authorities of the Thames that they should have co-ordinate powers with the Conservancy Commissioners to enforce the provisions of the Act. This was stedfastly resisted, not because there was any objection to anybody getting the Act put in force, but when they had two parties having co-ordinate powers the question would arise which should have priority, and one of them would try to prevent the other from acting. Then it was easy to begin litigation and let it hang for any number of years, and it would be unreasonable to allow offenders to be prosecuted by two parties for the same offence. Therefore, he personally was against the principle of leaving in the hands of local authorities the responsibility and power of dealing with the pollution of rivers.

Mr. C. GILBY (Bath) wished to say something in support of the recommendation as to the necessity of still greater attention being paid to prevent the great waste of water that goes on in the supply of the various towns in the kingdom. In support of that he would give them a few figures as to what had been done in the city with which he was connected. Some eight or nine years ago they had an intermittent service with a consumption of over thirty gallons per head. Acting under the advice of Mr. Binnie, who was called in, they adopted an instrument with which the name of the president of the section was so well known, with this result, that at the present time they were giving a constant service, with a consumption of water of eighteen gallons per head for all purposes, including a trade supply of two and a half gallons. He believed at the present time there was still at least twenty-five per cent. of the water brought into the city running to waste; and that only showed the necessity of great attention being paid to the subject, more particularly too as the cost of new supplies was rapidly increasing. He might say that the city in question was a water-closeted town. They had instances in which there were no fewer than four or five water-closets to each house, so that the use of water was rather high. It was also a district containing a large proportion of good residential properties.

Major **Lamorock Flower** (Lee Conservancy Board) said he was very glad to see Mr. Burt at the meeting and to learn the action of the Conservancy Board over the watershed of the river Thames. It was a story which he had long put before the world that, if they were to keep that river pure, they must have control over the whole of the watershed area of the river. He was afraid that the Thames Conservancy had hitherto been hampered immensely by simply having charge of a little narrow strip ten miles wide on either side; but now that state of things had passed away. With regard to Mr. Gilby's remarks about Bath, he was pleased to have an opportunity of saying a word, having himself some interest below Bath. He should like to draw attention to the terribly fouled condition of the river Avon, and he thought that the time had come when the Local Government Board should interfere to compel the good people of Bath to spend a little money in keeping their sewage out of the river, and to force the people of Bradford-on-Avon and Trowbridge to prevent pollution, so that those who go down to amuse themselves on the pretty reaches of the Avon could do so without being offended by the stinks which now drive them away. In his opinion, the papers read that day had grappled with the subject very fairly indeed. He did not quite agree with taking the manufacturers' refuse into the sewers. Mr. Cooper said they managed to do it all right in the districts he indicated, but it was a totally different thing in other places—for instance, at Tottenham, where they found it exceedingly hard, because of the refuse discharged from the india-rubber factory, which, consisting of sulphur compounds, produced very bad smells. In such cases, as he had said, the treatment of the sewage would be attended with very great difficulty. He thought, from an experience extending over a number of years, all manufacturers should be bound to deal with their refuse on their own premises.

The President of the Section (Mr. G. F. Deacon) said he should like to say a word on the observations made as to a separate system. It seemed to him that it was practically impossible, unless a separate system in some form or another were adopted, to purify their rivers to such an extent as would fit them for potable supplies. If they admitted the flood waters into the foul water sewers, and then allowed them to overflow without treatment into the rivers, the foul matters which had been standing during a dry season were turned into the rivers at the very moment when the river was at its worst, and the evil which they sought to prevent was thus aggravated. The practical difficulties and great cost of purifying the whole of the mixed sewage and flood water were so great that he saw no hope of doing it. He much preferred not to place the intake of any waterworks below sewage effluents; but if they must be so placed, he was satisfied that all the human excreta ought to be efficiently treated, and the separate system was the cheapest method with which efficient treatment could be combined.

Mr. C. Burt (Richmond) pointed out that there was no power at present existing by which Local Authorities could compel the separation of rain water falling on houses and gardens from sewage, which was a lamentable state of things, and ought promptly to be remedied.

Mr. A. Lowcock (Birmingham) said that Mr. Spinks, in his paper, referred to the Rivers Pollution Act being a dead letter. It appeared to him that that had been to a very great extent because the Act was permissive, and not compulsory. Another reason was, that the cost of putting it into action was so great that private people, who were prejudiced by the pollution of streams, were not really in a position to take advantage of the Act. It took so long, and cost so much to put the necessary machinery into force, that the Act was practically a dead letter. But in the district of the Mersey and the Irwell Board, where they had a special Act, red-tapeism was practically abolished. They only had one case which was fought, and in all the subsequent cases, they had only found it necessary to apply for powers in order to obtain an injunction. With regard to the admission of trade effluents into sewers, he entirely agreed with Major Flower. Manufacturers appear to think that they have a perfect right to discharge their works' effluents into the sewers, and Mr. Cooper seems to consider that a great hardship is inflicted on them if they are called upon to treat and purify these effluents themselves. It would undoubtedly be a hardship if the manufacturers in one town or one district were compelled to do so, while in other districts their competitors were permitted to put it into the sewers: but if it were done generally all over the country, as it undoubtedly should be, it would be no hardship, and would simply become a trade expense. The Local Authorities were not expected to take away solid refuse, and he failed to see any reason why they should take away liquid refuse. He had a case in his mind at the present time, where there were two large manufactories in an otherwise small district, and if the effluents from those two works were allowed to pass into the sewers, and to be taken down and treated at the expense of the Authority, the result would be that there would be ten times as much polluting matter contributed from these two works as there was from the whole of the rest of the district. The consequence would be that the rates would be saddled with the enormous expense, and the Local Authority with the responsibility of keeping the river free from pollution, all for the sake of these two manufactories. There was another point with reference to the self-purifying powers of rivers. There was no doubt that in purification of sewage by filtration, or whatever way it was done, the agencies at work were all one and the same, and it practically depended upon the nitrifying organisms. But in Mr.

Spinks' paper he gives a certain percentage of sewage which might be put into the rivers, although it does not say anything about the qualities or quantities of the sewage. It was very misleading, therefore, on that account, because the experiments referred to, which were made by Mr. J. P. Stearns, were carried out with sewage contributed at the rate of 100 gallons per head of the population per day; a rate very rarely reached in this country. If it was reduced to a proper proportion—the equivalent polluting agent, or rather the quantity of sewage containing an equivalent quantity of polluting matter—the permissible percentage would be very much less than he gave. Another consideration to be taken into account, was the condition of the river-water before the sewage was put in. Unless they knew what the constituents of the water of the river were, the quantity of dissolved oxygen in the water, and other particulars, it was impossible to lay down any sort of rule as to what percentage of sewage or putrescent matter could be turned into it; and as these conditions are different for every river, and for different parts of the same river, it is obviously impossible to fix any percentage or rule whatever. Professor Robinson, in his paper, had gone into a great many points, each of which would take far more time to discuss than was at their disposal. On page 576, he points out that light has a favourable action, or rather to a great extent has a favourable action, for it destroys the bacteria; and goes on to show that in shallow streams the agency of light is a more powerful factor in assisting the self-purifying action than in deep, sluggish rivers. It appeared to him very probable, however, that another factor which came into operation under these conditions was far more effective than the light, that was to say, the aëration, which was effective over much greater area in proportion to the bulk of the water. The dissolved oxygen in the water was much more rapidly renewed, and the consequence was the purification went on far more rapidly in shallow than in deep streams. It was much more due to that than to the action of light. He was very pleased to hear the two closing sentences of Professor Robinson's paper, as he had devoted a great deal of attention to the purification of sewage and water by micro-organisms, and had recently carried out a long series of experiments on this subject.

Professor E. HULL (London) expressed his gratification that the President had corrected a little misapprehension he (Professor Hull) was in as to his views on the well supply. Knowing the President's connection with the wells in Liverpool, he felt certain that was the result of his (the President's) experience. He felt gratified at having elicited the President's opinion on that point.

The PRESIDENT: It is in my address, but you missed it.

Professor HULL said there was no harm in having it reiterated. With regard to the point as to the source from whence water came in the New Red Sandstone deep wells, he must admit that, as Sir

Charles Cameron said, the pedigree of a great deal of the water was exceedingly questionable. The water which filtered through the sandstone rock downwards, and was drawn up from great depths at the pumping stations, came from all possible varieties of sources—some good, some bad, and some indifferent. But such was the extraordinary filtration power and purifying quality of the rock formation that, no matter what the source might be, when the water had got down several hundred feet into the rock it was practically perfectly pure and fit for all sorts of purposes, both domestic and manufacturing. That had been proved most clearly in the case of Manchester and Salford, where many wells were used for bleaching, brewing, and for other purposes; but unquestionably the water itself was largely derived from percolation through the bed of the Irwell into the sandstone over which it flows, and from other equally impure sources. It was one of the most remarkable things of the kind in the natural course of events with which he was acquainted. Undoubtedly, when a deep pumping station was started in a new neighbourhood the effect ultimately would be to dry the shallow wells which go down perhaps from fifty to a hundred feet. The underground water-level would be lowered by excessive pumping and the water would be drawn off from the wells.

Mr. W. SPINKS (Leeds) said with regard to Mr. Cooper's remarks about a separate system of sewerage, it must not be understood that he (Mr. Spinks) advocated that system. What he said was that in some cases it was partially adopted by the utilisation of old and abandoned drains—and which he knew in many instances were old rubble drains—which were very often full of sludge deposit, which rendered them in a filthy condition. It was quite true, as Mr. Cooper had told them, that where a separate system was in operation during periods of extraordinary drought, and where they had macadamised roads without any constant rain, the condition of that sewage was worse than the condition of crude sewage itself. He thought the analysis taken by chemists would prove that. With regard to what had been said as to trade effluents, mention had been made of one manufacturer in a small village being compelled to treat his sewage. That seemed to him to resolve itself into a question of combination between the local authority and the manufacturer. But when they came to large communities in the northern counties then he thought the policy of the Local Government Board, according to the letter he had quoted, was a sound one. He had had to conduct fights upon Local Government enquiries against manufacturers, and he thought the more closely they looked into it the more difficult the problem was of taking any trade effluent indiscriminately. As he had said before, where it was a question of one manufactory in a small village, that should be purely a matter of arrangement. This was an important matter just now, because in the West Riding of Yorkshire it was just coming on, whereas the Lancashire battles were almost over. The condition of the water was very materially improved in the Mersey. When he dealt with the question in Liverpool in 1890 he called attention to the probable condition of the Ship Canal, and unfortunately during the past four years very little had been done. But now at last there seemed to be every hope that the river would be so purified that perhaps—as the *Liverpool Echo* said—people would be able to catch salmon again below Latchford weir. At any rate, if that could not be done, it would be so purified that it would be no nuisance or danger to health, and Liverpool, of course, would feel the benefit from it much more than any other town.

On "*The Housing of the Working Classes: Sanitary Powers relating thereto, in Liverpool*," *by* W. GOLDSTRAW, Surveyor of Buildings, Liverpool.

WHEN the era of sanitary legislation began to dawn, more than fifty years ago, Liverpool was the first town to set a good example. In 1842, a local Act was passed "for the promotion of the health of the inhabitants" and "the better regulation of buildings." Before that date, builders of house property were on the whole left free to build as they pleased, so far at least as concerns questions of health.

The chief points in which the *Liverpool Building Act, 1842*, aimed at improving the sanitary condition of dwellings were these:—

Increased width of Streets and Courts;
Prohibition of certain Cellar Dwellings;
Ventilation of Rooms;
Provision of Sanitary Conveniences.

It was enacted that houses in streets were to have a space of 24 ft. between the opposite fronts, and houses in courts a space of 15 feet. It had been the custom to build houses arranged in courts 10 or 12 feet wide, the entrance to each court being a tunnel passage 3 feet wide under the upper storeys of the houses in the main street. These front houses, being in a continuous row, shut out ventilation from the courts at the rear. The courts were thus in shape and proportion not unlike a wine bottle placed on its side, the long neck of the bottle representing the covered passage or entry to the court. To remedy this evil, the Act of 1842 prohibited the building of a house in any court less than 15 feet wide at the entrance and throughout its whole length. But it was provided that the court might, if the Health Committee thought proper, be narrowed to 6 feet in width at the entrance by privies and ashpits 10 feet in height.

The unhealthiness of the old court houses was aggravated by the fact that many of them were cellar dwellings. In the Act of 1842, therefore, it was laid down that no cellar under a house in a court should be occupied as a dwelling-place. It was also enacted that all other cellars should cease to be occupied as separate dwellings unless certain requirements were complied with, such as (1) that the height of the room must not be less than 7 feet, of which one-third must be above the street, and (2) that there must be a fire-place, together with (3) a window, not less than 3 feet square, and (4) that the cellar should have attached thereto a privy and an ashpit, or rather "the use of" those conveniences. The erection of *new* cellar dwellings was stopped in effect by enacting that no house should be built without one room of 108 square feet on the ground floor.

By the Act referred to, the least height for inhabited rooms was fixed at 8 feet, and each ordinary room was required to have a window of at least 15 square feet, to open at top and bottom.

As to what are called "sanitary conveniences", it was required that every house, new or old, should have "a privy and ash-pit;" but it was allowed, even in the case of new houses (if in courts) that one of those conveniences might serve for several houses.

These were the chief points, specially affecting the dwellings of the poor, dealt with by the *Liverpool Building Act, 1842.*

In 1846, the *Liverpool Sanitary Act* was passed, and those provisions of the Building Act which have been referred to were transferred to it, with amendments. The required width of streets was increased to 30 feet; and no house must be built to exceed in height the width of the street. These regulations still remain substantially unaltered.

The requirements as to courts were extended, so that a court of minimum width (15 feet) could not contain more than eight houses, and for every additional house an extra width of 1 foot must be given. As to existing cellar dwellings, the regulations were made rather more stringent in some particulars. And in 1854, a further effort was made to tighten the restrictions as to cellar dwellings by the passing of the *Liverpool Sanitary Amendment Act.*

In 1864 local legislation of still greater importance was effected. *The Sanitary Amendment Act* of that year required that every new court must open at each end for its full width into a public street, unless the court was 25 ft. wide, when one end might be closed.

As to the *old* courts it must be said that in 1863 they had reached a climax of badness both in condition and in number. There were then in Liverpool 3,173 courts, containing 18,610 houses, in which lived about 112,000 persons, or nearly a fourth of the whole population of the Borough. In the following year, powers were obtained to demolish the objectionable courts by legal process, at the public expense, and to prevent the erection of unventilated courts in future. These powers were conferred by the *Liverpool Sanitary Amendment Act, 1864,* already mentioned—the statute under which the demolition of insanitary property is still mainly carried on.

Another local statute of the same year, *The Liverpool Improvement Act, 1864,* imposed new requirements as to sanitary conveniences.

But the health provisions of the two Acts of 1864, though of great value, were perhaps exceeded in importance by a short *Bye-law* made in the same year on the subject of *Open Space in connection with dwelling-houses.* Until this time, ordinary houses in streets had been built with little or no regard to ventilation at the rear. Court houses were even worse; for they were built back-to-back. But the *Bye-law as to Open Space, 1864,* caused a great improvement in this respect. It was prescribed that every new house of two storeys in height should have an open yard at the rear or side containing at least 150 square feet, with a distance of 15 feet across between the back of the house and the opposite property; or the distance across in the case of a three-storey house must be at least 20 feet, and for a house of more than three storeys 25 feet. This salutary bye-law remained in force until 1890; and by that time there had been built in accordance with it about 33,000 houses, which, at five persons to each house, will accommodate 165,000 persons, or about one-third of the whole population of the Borough at that date.

The year 1864, then, saw a new departure in the application of sanitary powers to dwelling-houses. With the exception of the complete sewering and draining of the Borough, no reform in the sanitary government of Liverpool has equalled in importance the powers acquired in 1864.

Shortly after this time it seems to have been thought that the building regulations operated harshly with regard to blocks of labourers' dwellings. Accordingly, powers were obtained in the *Liverpool Improvement and Waterworks Act, 1871,* to relax or modify the regulations as to height of buildings, courts, and open spaces, when applied to blocks of more than fifty separate dwellings, provided that the City Engineer and the Medical Officer of Health jointly certify that adequate provision is made for the proper circulation of air and ventilation.

In 1871, the restrictions as to occupation of cellar dwellings were further amended in certain details by a local *Improvement Act.* But best of all, in this regard, the *Public Health Act, 1875*, has clearly laid down that no cellars are to be occupied as dwellings unless they were lawfully so occupied at the passing of the Act, and not even then unless certain structural conditions are fulfilled. It hardly need be said that no cellar dwellings have been constructed in Liverpool for more than twenty years past.

Further powers affecting dwelling-houses were obtained in the *Liverpool Improvement Act, 1882.* when the Corporation were enabled to deal more effectually with cases of land filled up with offensive material, of streets laid out in awkward directions, of houses being built with damp foundations, and of buildings illegally occupied as dwelling-houses.

The next sanitary measure bearing on the present subject was the *Liverpool Corporation Act, 1889.* That Act requires that every new street which does not open at each end for its full width into another street shall be not less than 36 feet wide. It also requires that every new court shall at each end open at its full width into a street at least 30 feet wide. It is therefore no longer possible to construct a court which is enclosed in any way except on two opposite sides: and the only reason now left for applying the term "court" to such an arrangement is that by the statutory definition a street which contains houses and which is not formed for carriage traffic is a "court."

But the chief sanitary provision in the Act of 1889 has been of more real importance than anyone not officially concerned seems to be aware of. It is the prohibition of any erection on the existing open spaces in connection with houses, unless in accordance with certain regulations. The effect is that every such open space formed prior to that date, whether originally required by law or not, must now be preserved, within certain limits, unless the Corporation consent to some modification. Few things of the kind could be more valuable.

These regulations as to open space were afterwards applied with great advantage to all new houses by the adoption of a new *Bye-law* on the subject in *1890.* In this Bye-law there are two distinctive features which are worthy of note. The first is that the distance across the open space to be provided at the rear of every house must be not less than the height of the rear wall of the house, so that the house must not rise above a line drawn at an angle of 45 degrees from the line of the opposite property at the rear. The second distinctive feature is that the open space required must on each of three sides abut on a similar open space or on a street. The result is that the open space can never be blocked in by adjoining buildings, but must always share in and contribute to the through ventilation along the rear of all the adjacent houses. And a secondary result is that rows of houses are now separated from other buildings by cross passages, which break the continuity of the solid frontages, and assist the circulation of air. There does not appear to be any other town which has a Bye-law possessing these characteristics. *(See Appendix.)*

No reference has been made in this paper to the rather numerous and complicated statutes known as the *Artisans' Dwellings Acts*, and it is hardly possible to attempt such a reference. This important branch of the subject would require the whole of a special paper to do it justice.

With this very large exception, we have now traced in outline all the general sanitary powers of the Corporation with regard to the housing of the working classes, and it only remains to inquire, What is the broad result, as seen at the present time?

The answer to this question may best be given, briefly, in the form of statistics, taken at the end of 1893.

The number of dwelling houses of all kinds at present existing in the city is 106,946. Of this number, it is reckoned that about 82,444 are let at gross rentals of not more than £20 a year, or 7s. 8d. per week. It may, therefore, be said that 77 per cent. of the dwelling houses within the city are occupied by the "working classes."

Out of this total number of 82,444 houses of the working classes, 26,182, or 32 per cent. have been erected since 1864, under the improved regulations, and may be regarded as being in a fairly sanitary condition, and having sufficient open space.

A further distinction may be drawn by classifying the occupiers of houses of which the gross rental is not more than £13 a year, or 5s. 0d. per week, as "the labouring class."

Under this heading there are in the City about 40,400 houses, *i.e.*, 38 per cent. of the whole number of houses in the City.

In this number of "labouring class" houses, there appear to be about 14,600 which are "insanitary," and which ought to be demolished or structurally improved. This may seem a large number; but it should be stated that during the thirty years that the Corporation have had the requisite powers, 4,126 houses have been so dealt with, at a cost of about £265,580 to the ratepayers. It may, therefore, be reasonably expected that during the next thirty years the remainder will be cleared away by the action of the Corporation combined with the forces of natural decay and of lawless destruction.

When that consummation is reached it may be hoped that Liverpool will have a labouring population moderately well-housed. But as a precedent condition it will be necessary that the newer houses be let at such rentals as "the labouring class" can afford to pay. This is certainly not the case at present; for the smallest houses now being built (with the exception of a very few tenement houses) are generally let at rentals of 5s. 6d. per week, which is about double the sum which thousands in that rank in life can possibly spend on house-rent. These unfortunate or unthrifty ones now inhabit the dilapidated and insanitary houses which must, in no long time, disappear. But where will they or their like successors live when the court houses and cellar dwellings have gone? This problem is still unsolved: yet we may hope that it is not insoluble.

APPENDIX.

CITY OF LIVERPOOL.—BYE-LAWS WITH RESPECT TO NEW BUILDINGS.

Open Space at Rear.

4.—Every new dwelling-house begun to be built or re-built after the commencement of these Bye-laws shall, except as hereinafter mentioned, have at the rear thereof an open space immediately adjoining and exclusively belonging thereto, and extending throughout the rear thereof, and of an aggregate extent of not less than 150 square feet, and free from any erection thereon above the level of the ground floor of such house, except a water-closet, or earth closet or privy, and an ashpit, and a storage cistern for water, and the fence walls of such open space; the highest part of any such water-closet, earth closet, privy, or ashpit, or of such fence walls, being not more than 8 feet in height above the level of the ground floor of such house, and the superficial area occupied by such water-closet, or earth closet and privy or ashpit, including the walls thereof, shall not exceed together 50 feet.

The distance across such open space, or across such open space and not exceeding 9 feet of any street immediately adjoining thereto, measured at right angles from any wall of such house which abuts on the open space, shall (subject as hereinbefore mentioned) be not less than the height of such wall above the ground floor of the house, such height being measured to the highest part of the wall where the same terminates at the eaves. Provided that if the roof or any part of such house (except any open parapet and any chimney) shall rise above an imaginary line drawn at an angle of 45 degrees with the level of the ground floor from any point to which the distance across may be measured, then the distance across shall be not less than the total height of the house measured from the ground floor thereof to the highest point rising above such imaginary line.

Provided also that in any case the least distance across such open space, measured in manner aforesaid (exclusive of any street or part of a street), shall be not less than 5 feet; and in any case where any wall of such house abutting on such open space exceeds 20 feet, and does not exceed 30 feet in height above the ground floor, such least distance across shall be not less than 10 feet; and in any case where any such wall exceeds 30 feet in height above the ground floor, such least distance across shall be not less than 15 feet.

And provided also that where the back of such house has a window in each storey opening to a street not less than 9 feet wide, then the open space as herein specified may be situate at the side of such house instead of at the rear.

Such open space, when situate at the rear, shall on each of three sides thereof adjoin another open space exclusively belonging to a dwelling-house, or adjoin a street having direct communication at each end with a street not less than 25 feet wide; unless such open space at the rear is of an aggregate extent of not less than 500 square feet, exclusively belonging to such house. (*"Allowed" by the Local Government Board, 13th February, 1890.*)

[*For discussion on this paper see page* 621.]

On "The Housing of the Working Classes: Tenement Houses, or Dwellings in Flats," by H. PERCY BOULNOIS, M.Inst.C.E., City Engineer, Liverpool.

(FELLOW.)

THE subject of this short paper will be treated within two chief limitations: one is that, generally speaking, facts will be stated rather than arguments or opinions, the other is that the facts will be drawn mainly from Liverpool.

It may reasonably be assumed that in this Congress it is well known that the question of the housing of the working classes is a rather difficult problem, and it may be supposed that the general conditions of the problem are understood. It may be well, however, to define the expression "working classes" for the present purpose by taking it to apply only to the tenants of houses which are rented at not more than £20 a year, or about 7s. 8d. per week—a limit which is quite sufficiently high. It may also be premised that one condition which has been rather strongly insisted on is that the rent to be paid by the poorest of working people ought not to exceed an average of *one shilling per room per week.* (See Appendix A.)

Now it is a fact which will cause no surprise that in Liverpool the nearest approaches which have been made towards a compliance with this requirement have been in "tenement" houses or dwellings in "flats." As to the ordinary houses, all those which have been built in this city during the last thirty years may be said to come under two classes—six-roomed houses letting at a rent of about 7s. 6d. per week, and four-roomed cottages letting at a minimum rent of 5s. per week. It may therefore be reckoned that the rents of the usual modern houses average 1s. 3d. per room per week. It is said that these rents are too high for labouring men who earn only 20s., or perhaps only 18s., per week when in regular employment, and too high also for those whose weekly earnings are from 24s. to 30s., but are reduced to an average of 15s. or 20s. per week by the lack of regular work. It is urged that persons of this condition in life cannot possibly pay more than one-fifth of their income in rent, *i.e.*, a sum of 3s. or 4s. per week, including rates and taxes.

But none of the cottages built here since 1864 can be let at the low rentals just mentioned. And it is hardly probable that any such will be built in the near future, unless, perhaps, on certain sites which may have been cleared of insanitary property by the Corporation, and which may be too shallow to contain four-roomed cottages of two rooms in depth. It is no doubt conceivable that if the Corporation think that houses of three rooms, or even two rooms, are desirable, they may encourage or require the erection of such houses, when selling the cleared sites, and may impose a condition that the rents shall not exceed one shilling per room per week. In that case, the independent cottage, so dear to the British workman, could possibly be had at the stipulated rent. But such houses would be few in number, and their size would be small. It would hardly be possible to afford rooms of greater dimensions than 12 ft. by 10 ft. by 9 ft. in height.

And here would arise an objection, which is frequently made, to the effect that houses containing less than four rooms ought not to be permitted. Indeed, I have received letters from very estimable and warm-hearted persons protesting against the Corporation allowing the erection of the four-roomed cottages of the now prevailing type, on the ground that even working men's families cannot live decently in houses with such limited accommodation. In response to this suggestion it can only be said that there are many families which do not require more than two, or perhaps three, ordinary rooms for reasonable conditions of decency and health, and many more which cannot possibly pay a greater rent than those two, or three, rooms must of necessity command.

It is a fact, however, that houses of less than four rooms, and of less than 5s. rental, cannot be had in Liverpool, unless in the insanitary back-to-back houses which the Corporation are compulsorily demolishing, or in some of the tenement blocks which are regarded by many persons as the only means of meeting the requirements of the case. We may, therefore, now turn to the consideration of what has been done in this city in the erection of tenement dwellings.

There is a comparatively large number of houses erected in rows or blocks of two storeys in height, in which there is on the "ground floor" level, a series of complete houses, each containing two or three rooms, and in which there is on the "first floor" level, another set of complete houses of the same dimensions as those below, each one entered by an independent stair directly from the street. These are commonly known as "Scotch" houses, though the term appears to be rather a misnomer. The number of such houses cannot readily be ascertained, but it certainly reaches to several thousands. Each dwelling usually comprises two rooms only; and the rent is from 3s. 9d. to 4s.* Structurally, this kind of house would seem to be the first stage in the evolution of the "block" type; but chronologically it is not so, at least in Liverpool.

Of "tenement" houses, "terrace" houses, or dwellings in "flats," more properly so-called, there are about 120 blocks, containing some 3,000 houses or dwellings. They vary somewhat as to size, arrangement, and rental; and as there has been a degree of development in their characteristics, it may be well to briefly describe some of them, as nearly as possible in order of date. (The lettered examples refer to the diagrams at page 624.)

EXAMPLE A.

The first attempt to provide cheap dwellings on this system appears to have been made in 1863, the year before the bye-law as to open space was procured. No wonder, then, that the open space provided does not extend throughout the rear, and that the extreme back walls of the houses abut directly on a three feet passage. The block is three storeys in height, with separate houses on each floor, approached by a common stair in the middle of the block, and by continuous balconies facing the front street. Each tenement is compact and comfortable, is fairly well lighted and ventilated, has three rooms of medium size, and is let at a rent of 4s. or 3s. 6d., according to position, *i.e.*, at the rate of 1s. 4d. and 1s. 2d. per room.

---

* See, however, the rentals of similar houses referred to under *Example H*, page 619.

In an adjoining street there is a tenement block which was erected in 1867. It is four storeys in height and contains forty dwellings of three rooms each. A common stair and a continuous balcony at each storey give access to the houses. The open space at the rear is not in accordance with the bye-law. The dimensions of the rooms are rather larger than is usual in such houses, being as follows:—Living Room, 17 ft. 3 ins. by 11 ft. 2 in.; Bed-room, 14 ft. by 11 ft.; Scullery, 8 ft. 9 in. by 4 ft. 6 in. The rents diminish in the upper storeys, and are 5s. 6d., 5s., 4s. 6d., and 4s. respectively; or 1s. 10d., 1s. 8d., 1s. 6d. and 1s. 4d. per room.

On the opposite side of the same street there is a three storey block, arranged on a similar plan, but with more open space at the rear, and consisting of *four*-roomed houses. The rents are 6s. 6d., 5s., and 4s. 6d.; or 1s. 7½d., 1s. 3d., and 1s. 1½d. per room.

These three blocks of dwellings, together with some others similar, in adjacent streets, were erected by an able and enterprizing builder who still retains the ownership. The rents were higher for the first fifteen years, and there was seldom an empty house, although the site is a mile and a quarter from the docks, and there are no "works" in the neighbourhood. At the present time 17 per cent. of the houses are unoccupied. The owner cheerfully considers that the result of his speculation has not been unsatisfactory, the present nett return on the outlay being about 4 per cent., but he would hesitate to increase the number of such houses.* The opinion of the owner of a similar block in the same street is more decidedly adverse.

---

* Amongst the reasons why this class of property is not a desirable investment, the owner referred to gives the following:—"Many of this class of tenants are very migratory from various causes, the house becoming void perhaps for weeks. Then again, there is sickness, accident to the breadwinner, partial or no employment, and these tenants as a rule have little or no thrift. So in these cases the owner's rental suffers. And if you consider they are sober and honest, you hesitate to evict. Then arrears accumulate, which are seldom recovered."

EXAMPLE B.

In 1865, whilst the groups just described were in course of erection, a rather considerable scheme was carried through by an experienced architect, who designed and erected, for his own personal investment, several blocks of tenement houses in three spacious streets adjacent to each other. They are three storeys in height, with a continuous balcony at the level of each floor, and a large open space at the rear. On this space wash-houses were erected. But neither the common yard nor the wash-houses are used as intended. The one is a harbour for filth, and the others have fallen to ruin. The tenants could not agree in the joint occupation. There are fifty-one tenements in all, each containing four rooms of medium dimensions. The rents are from 4s. 6d. to 5s. 9d. per week, and they are said to yield a fair return to the present owners. It is said, however, that the original owner regarded the venture as an unfortunate one. The houses are over three-quarters of a mile from the docks, and 10 per cent. are unoccupied.

EXAMPLE C.

In 1867, another tenement block of a different kind was erected at a much greater distance from the docks. The entire building is three storeys in height, and is divided into eighteen dwellings in the ground storey, each containing four rooms, and into eighteen dwellings in the two upper storeys (taken together) each containing six rooms. It will be noticed that this three-storey block is arranged in two flats, the lower houses being of one storey, and the upper houses being of two storeys in height. In this respect, the block in question was the first of a type which has been rather frequently reproduced in the city. Another special feature is the construction of a yard for each of the upper houses, over the rear portion of the yard of the lower houses. The bye-law as to open space, which had then been in force for three years, is not complied with. There seems to have been a disposition on the part of the Corporation to encourage the erection of such dwellings, presumably in the hope of meeting the wants of the poor; though it must be admitted that the six-roomed houses in the upper storey were not a decided step in that direction. The projecting back wings of the houses are rather close to each other, and, consequently, the back rooms in the ground storey are very badly lighted. Whether from this circumstance, or from the too great size of the upper houses, or from the remoteness of the situation, the scheme seems to have been a failure. It is asserted that the clear profit on capital invested, for the year ending in March last, was *nil.* The rents are 3s. 6d. and 5s. 6d., rates which are below the standard we have fixed, being only 10½d. and 11d. respectively. In this case, it seems that cheap houses for the tenants mean no profits for the owners.*

However that may be, the erection of these buildings, and of those previously described, was regarded at the time as a fairly successful attempt to supply the great desideratum of cheap dwellings for the labouring classes. And accordingly the Corporation were moved to set about the erection of similar houses.

EXAMPLE D.

After discussing and modifying various designs for four years, in 1868 they erected the six blocks of labourers' dwellings known as the St. Martin's Cottages, on a large plot of ground abutting on Silvester Street and Ashfield Street. The four outer blocks are five storeys in height, including a basement half-way out of the ground; and the two inner blocks are three storeys in height. There are 20 tenements of four rooms each, 42 of three rooms, and 84 of two rooms, making 146 houses in all. The houses are only moderately well occupied, being somewhat gloomy; and the basement dwellings have had to be given up, as being insanitary. The respective rents are, on an average, 5s. 6d., 4s. 6d., and 3s. 0d., including gas. If 3d. per week is reckoned off for gas, the lettings are at the rate of 1s. 3¾d., 1s. 5d., and 1s. 4½d. per room. The nett return on the capital expended has averaged about 3½ per cent., but is now much less.

The next experiment was made by a Company formed by public-spirited Liverpool men, who built, in 1868 two blocks of terrace houses within a stone's throw of the Corporation dwellings. The buildings are four storeys in height, with continuous balconies throughout. A fairly large open space is provided, the property is in good repair but dirty, and there are few empty houses. The blocks are divided into 130 tenements of two or three rooms, and four or five rooms, and are now let at rents varying from 3s. 6d. to 5s. 0d. The Company has recently transferred the property to an individual owner.

---

* The owners say, "We do not consider this class of houses desirable property from either builders' or owners' point of view. Such property, in our opinion, has a tendency to lower the status of tenants by bringing them into a too near relation with each other. Tenants of such property leave in batches together. This is only one reason why the property does not pay." Another reason is that "a low class is bound to get in, do as you will; and the result is that they allow dirt to accumulate. choking spouts and drains. If this occurs with the tenants above, it will also affect the tenants below, and often fevers are the result."

EXAMPLE E.

At about the same time, that is, 1869 to 1871, two large blocks were built nearer to the northern boundary of the borough, and very near to the line of docks. Each block occupies the whole of one side of a street which opens at each end into a main road where tramways are laid. No conditions could be more favourable. A large common open space was provided at the rear of each block. Each of the three storeys forms a separate "flat," and has a continuous balcony running along the front. Every house consists of a living room, three bed-rooms, and a scullery with other convenient places, making practically a five-roomed tenement. But even if we reckon it as having only four rooms, it will be found that as the rents are 5s., 4s. 6d., and 4s., according to the height, the rate per room is but 1s. 3d., 1s. 1½d., or 1s., as the case may be. And as the rent includes a free gas supply, worth say 3d. per week, the rate per room is actually reduced to 1s. 2¼d., 1s. 0¾d., and 11¼d.

Surely, it will be said, here is a success. Unfortunately, the facts tell a different tale. Whether it is that the houses are practically too large for the wretched class of tenants, who might prefer a two-roomed house at half-a-crown a week to a four-roomed one at 4s., or whether the property generally is rather unattractive from its want of repair—not a strong reason with such tenants—certain it is that the houses "let" badly. Out of 180 tenements in the street, there are 41, or nearly 23 per cent. which are unoccupied, and many of which have apparently been so for years past. Almost all the houses are dirty and somewhat disreputable-looking. The fine open spaces at the rear are of no advantage as either drying-grounds or playgrounds; they are places for refuse and ruffians. One section of the property is under the management of an agent of wide experience and high standing, who evidently is striving to keep it in good repair, and to secure fairly suitable tenants. Yet he assures me that "the rents collected are not sufficient to pay charges—viz., rates, gas, and ground-rent." *

I have dwelt a little on this example, because it is typical

---

* This gentleman places the causes of failure under two heads:—

1. *Infectious Disease.* "Whenever there is sickness of a contagious or infectious character in the block, the more timid (who are generally the best tenants and have something to lose) remove to fresh quarters."

2. *Quarrelsome Neighbours.* "In the better class of other houses, ranging from 5s. to 7s. 6d. per week, I find this a source of trouble and considerable expense; but in tenement houses it becomes acute and chronic, and the result is a constant change of tenants, with constant expense for cleaning and repairs."

of a number of very similar cases, which need not be referred to in any detail. One block in particular, in the same neighbourhood, would answer in nearly all particulars to the above description, except that the balconies overlook the open space at the rear, which is even more unsightly and offensive than the others. These are indeed "waste" spaces in almost every sense.

We may now leave the period, referred to above, with the remark that it was during the years from 1863 to 1871 that the tendency to the erection of dwellings in "flats" was most strongly manifested. Trade was good, and wages were high: the newly-erected tenement property then paid easily 10 per cent. on the outlay. In many of these cases the return is now, as we have seen, practically nothing.

After that time there were a few spasmodic ventures in this class of building, but there was no movement of special interest until 1883, when the Corporation undertook the erection of four large blocks, since called the Victoria Square Dwellings, on a site which had been cleared of insanitary property by a compulsory demolition, known as the Nash Grove scheme.

These imposing erections were designed by the City Engineer of that time. The cost of the buildings alone was £58,000. They are five storeys in height, and 272 tenements have been provided at rentals of 5s. 3d. for three rooms, 4s. 3d. for two rooms, and 2s. 9d. for one room, inclusive of gas. It will be seen that the rates per room, when 3d. per week is deducted for gas, are 1s. 8d., 2s. 0d., and 2s. 6d. This is much above the 1s. 0d. standard. The Corporation are able to secure the reasonable return of 2½ per cent., and to provide good houses at a moderate rent; but the problem before us is hardly one step advanced towards a solution.

Example G.

In 1887, however, the Corporation made another incursion into the region which we are exploring. They erected, on the opposite side of the street to the dwellings just mentioned, four blocks of tenements, each four storeys high and comprising 100 separate dwellings. They were erected to the premiated designs of eminent Liverpool architects; and they form, probably, one of the best examples of good and inexpensive dwellings on the block system which have yet been devised. The interest received by the Corporation on the total cost is about 3½ per cent. The rentals of the two classes of dwellings are as follows:—two rooms 4s. 0d.; one room 2s. 6d.

It appears, therefore, that the desired one shilling rate has not nearly been reached.

EXAMPLE H.

It now only remains to refer to the latest instance,—and that on a small scale,—of the erection of tenement houses. A large owner of property, who has had a wide experience, has just finished the erection of twenty self-contained cottages in "flats," in blocks of two storeys. They were planned by an able civil engineer and architect, who also is fully acquainted with all the conditions of the problem. This is, in a great degree, a reversion to the type of the so-called "Scotch" houses, which were so much in vogue when the fashion of larger blocks set in. But it is a developed type. The upper houses have a small yard at the rear, on the same level as the living rooms: and the water-closets and dust-shoots are detached from the main building. There is a rather large open space on the ground level at the rear of each house, the bye-law in that behalf being fully complied with. Each tenement consists of three rooms, and is let at a rental of 5s. 6d. or 5s. 0d. per week. Here, then, we have a case of the looked-for kind of houses—houses having the character of independent cottages, with a reasonable minimum of accommodation, but with a rent at the rate of 1s. 8d. to 1s. 10d. per room. The great point of interest is the question whether in twenty-five years' time it will be found that, in spite of all leakage and deterioration, this property will, from the owners' point of view, sufficiently justify its existence.

This last-cited example is only one of several indications that the ordinary builders and owners of cottage property do not now regard the "tenement" or "flat" type of house with favour. If therefore it should seem (as it is by no means certain) that in order to provide houses at a sufficiently low rental it is necessary to place small tenements one above another, and so reduce the cost of land per house, it is evident that the ordinary builder will not readily undertake the supply. So far as he is concerned, the past experiments have been chiefly failures. The dilapidated and dirty condition of the tenement blocks which are in the hands of individual owners, and the great losses which those owners undoubtedly suffer from low-class and unmanageable tenants, seem to point to the conclusion that such blocks should be owned and managed by powerful bodies, companies or corporations, who could and would keep both the buildings and the tenants in fairly decent order. The cheapest of cheap dwellings are unquestionably wanted; they can only be supplied by the strongest of strong hands. (See Appendix B.)

APPENDIX A.

On the 6th November, 1883, a very able paper on this subject was read at the Liverpool Diocesan Conference by Mr. Arthur B. Forwood, at that time Chairman of the Insanitary Property Committee of the City Council, now the Right Honourable A. B. Forwood, M.P., and still a member of the Council. The title of the paper was "The Dwellings of the Industrial Classes in the Diocese of Liverpool, and how to improve them." The paper was afterwards published in pamphlet form; and on page 25 I find the following interesting passage:—"In Liverpool there is an excessive supply of labour, and in consequence employment is in far too many cases casual. The ordinary dock-side labourer, for whose position we have more especially to provide, earns 4s. to 4s. 6d. per day, but the average weekly earnings of this class do not, I believe, exceed 15s. If his work was constant, he could better afford 4s. 6d. to 5s. per week rent than he can now raise his share of 2s. 9d. for a court house. It is a moot politico-economic problem whether, if we improve house accommodation out of the public purse, thus making rents abnormally low, we shall induce increased numbers to come to the town, and so increase the present over-supply of labour. If we were free to act as we pleased, I should pause to weigh well this phase of the question. As it is, however, we have the people living in unwholesome dwellings, and they must be removed. The problem to be solved is, How best can we accommodate the industrial classes at *a Rental of* ONE *Shilling per Week per Room?* This shilling rental is the all-important factor, for no man with a family ought to occupy less than three rooms, and 3s. is as much as the average Liverpool workman can afford to pay. 3s. per week returns £5 per house per annum to the owner, and no private person will build cottages costing £150 upon such a return."

The One Shilling standard has also been aimed at in a report made in 1884 by my predecessor in the office of City Engineer of Liverpool, Mr. Clement Dunscombe.

APPENDIX B.

This conclusion—that the efforts of private owners cannot meet the case—to which I have been unwillingly forced by the logic of facts, is confirmed by the opinion of Mr. Forwood in the paper referred to above. For instance, take the following passage, in addition to the one already quoted:—"Our object should be to discourage the all-prevailing system of sub-letting houses by the rooms. True, we have legal powers to regulate them, and no less than 15,000 are on the registers. It is better however to provide single tenements at a cheap rate rather than that tenants should strive to pay a high rent by sub-letting; and the Corporation as landlords can better enforce such a condition than can individual owners."

[*This discussion applies to the papers by* Mr. W. GOLDSTRAW *and* Mr. H. PERCY BOULNOIS.]

The PRESIDENT of the Section (Mr. G. F. Deacon) said there were few problems more important than how to provide dwellings for the lower classes which should give a reasonable return to the owner of the property, and there was no better way of meeting the problem than to know the position in which they at present stood with regard to the matter. That position had been laid before them in as excellent a manner as was possible by Mr. Goldstraw and Mr. Boulnois, and he would ask them now to enter upon the discussion of the subject.

Sir FRANCIS POWELL, M.P., President of the Congress, said that in the valuable group of papers they were dealing more with the minute technicalities of the difficult problem, than with the general factors of the case. He thought the papers they had heard, like documents which had been considered on former occasions, were not of an encouraging character. It seemed to him, as far as he had been able to investigate the matter, that the cost of providing dwellings in which the humblest of their people might live under conditions of decency, to say nothing of comfort, was really in excess of the wages which they had at their command. The more they discussed the question, the more they thrashed it out, the greater the difficulty would appear. The question had been dealt with by Parliament. The Housing of the Working Classes Act gave power to municipal authorities to erect these buildings; but a defect was found in the Act, because there was no power given to local authorities to borrow for this purpose. He believed the framers of the Act intended they should have that power, but the draughtsman on the occasion did not fully accomplish his task. But, however, last session the defect had been removed, and now it was competent for local authorities, with the consent of the Local Government Board, to borrow money. He doubted very much whether it was possible to make the erection of these houses so remunerative as to attract private capital, because they must remember that if they were to pay at all, these houses would be extremely perishable. They were in the hands of tenants who did not take the care of them which they ought, and the lives of the houses would, he believed, in most cases be short. That was only putting back the difficulty, and it did not make it any more easy, because those who built houses only to last a few years had to replace the whole of their capital, and they had to receive a fair remuneration meanwhile; so that a cheap house would pay no better in the long run than a dear house. He was extremely anxious that nothing should be done by municipalities, which should place the common fund in competition with private capital, because he was sure the latter would retire from the scene. Private capital had retired already, and the capitalist—generally speaking, under those circles, a man of humble means—no longer chose to invest his capital in property of that kind. He therefore felt that when they had to deal with a population gathered together as in Liverpool, necessarily within a limited area, they must have recourse to the public funds. He might be wrong. He hoped that he was, because he was not disposed to draw on the capital of municipalities for that purpose: but he was afraid in a place like Liverpool they were driven to that position. He doubted very much whether it would be possible to accommodate these people without some recourse to the public fund. He was very much struck by the remark made by the gentleman who read the first paper, in which he said that no court should be allowed to be erected except opening on to a street 30 feet wide. He knew the courts of Liverpool, and if he was a mortal enemy of anything, it was to the courts of the city: and he said before the Parliamentary Committee: "I have one suggestion to make to the promoters of this Bill, which may properly form a clause, and it is to state that henceforth there shall be no court erected, except both ends of it open into a street thirty feet wide." The promoters of the Liverpool Corporation Bill, in the most cheerful spirit, accepted his suggestion, and the result had been the entire abolition of the bad features of the Liverpool courts, so far as regards these dwellings.

Dr. J. F. J. SYKES (Medical Officer of Health, St. Pancras) said they were all indebted to Mr. Goldstraw and Mr. Boulnois for reading papers of such interest, and placing before them so clearly the fact that that class of dwellings did not pay. His experience in London was exactly the same as that which had been described by Mr. Boulnois. These large blocks of dwellings did not pay. The London County Council had actually to increase the price of their dwellings, because they found they could not pay 3¼ per cent.: that was a condition also which would tell against the erection of that class of dwellings. In London the standard was 2s. 6d. per room, certainly not lower than 2s. 0d.; it depended very much on the size of the room. The London County Council adopted a minimum area of 12 by 8, and a height of nearly 9 feet. It was not only a question of the cost of the land, but also one of accommodation; what was the minimum accommodation that could be given. He ventured to think that there would be an absolute necessity for building that class of dwelling. He did not see how they were to avoid it unless they intended to carry the whole of their working class population into the country. Mr. Boulnois suggested that no dwellings should be constructed of less than four rooms. But he would ask, were four rooms always necessary?

Mr. H. P. **Boulnois**: I did not say anything of the kind; if you refer to my paper, I simply said that some philanthropists had written to say so.

Dr. **Sykes**: Then that is not your opinion?

Mr. H. P. **Boulnois**: No, not at all.

Dr. J. F. J. **Sykes** (St. Pancras) continuing, said Mr. Boulnois did not commit himself as to what the necessary accommodation should be, and he (Dr. Sykes) thought it was important that they should consider that before anything else. The London County Council had made it an indispensable thing that every w.c. erected in the dwellings under their care shall open into an open lobby—that was to say, it shall not be approached from the interior of the house, and have no direct communication with the inside. It was also necessary that there should be attached to each house a small open space, so that it should be possible for the occupants to stand the dust pails, etc., in a proper manner. In associated dwellings they got over much of the difficulty by having the wash-house and the w.c. entirely separate, so that practically for the dwelling what they required would be a kitchen and one or more bed-rooms, according to the family. In London the cost of rooms averaged about 2s. 6d., and that made 7s. 6d. for the rent of three rooms; whereas in Liverpool a six-roomed house let at 7s. 6d.; there was therefore a vast difference. The problem was much more easily solved in Liverpool, and if that city could not make the building of these houses pay, how much less was there a chance of the London houses paying.

Dr. **Permewan** (Liverpool) said he had had much experience in the slums of Liverpool. Taking Mr. Goldstraw's paper, they must all admit that the sanitary legislation of this country owed a great deal to the initiative of Liverpool, and great credit was due to the Corporation for having undertaken works of such magnitude, and with success. But it did seem to him that, with the large number of houses still in an insanitary state, their demolition at the present rate of progress would involve a very considerable time. Mr. Goldstraw said there were over 14,000 insanitary houses still in Liverpool, and that during the last thirty years 4,100 had been demolished. If they went on at that rate they would take something like 120 years before all the insanitary houses were demolished. While he quite admitted the great success of the Liverpool Act of 1864, he would like to ask Mr. Boulnois whether he did not think the time had come for the adoption of the Artisans' Dwellings Act of 1890—more particularly the first part of that Act. From what he knew of the north end of Liverpool, if ever there was a town ripe for the adoption of this particular part of the Act, Liverpool was that town.

As regards the cost of providing houses of this description he was very much struck with Sir Francis Powell's remarks, and he would like to add to them. It was quite clear that if the cost of providing houses for the very poor could not be borne by the poor themselves the private capitalist would not come forward, and it was necessary that it should be borne by public Corporations. That might be to some extent an economy in the end, because if they had poor people housed in insanitary conditions they would be subject to disease in a great class of the community, whereas, if they were in good houses, the community would be saved a great deal of expense in poor-rates and poor-law infirmaries. As regards the class of dwellings, that was a difficult problem. His experience was that, from the point of view of infectious disease, large tenement houses were exceedingly undesirable. Of all the types shown on the plan, that which Mr. Boulnois called the Scotch system, the more modern variation of it, namely, the cottage flat, seemed on the whole to be the most suitable, as far as Liverpool was concerned.

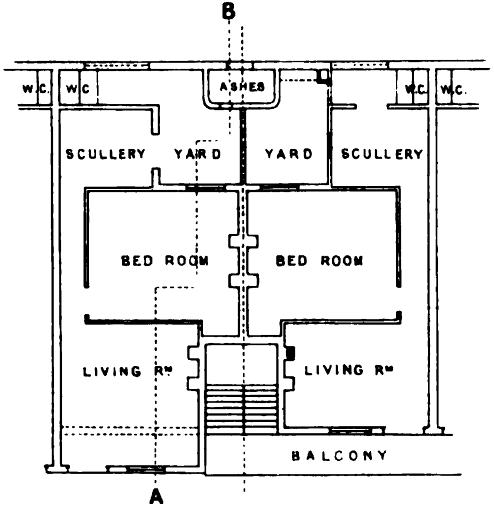
Mr. H. H. Collins (District Surveyor for the Eastern Division of the City of London) said that having had a very large experience in designing and erecting dwellings of this character, more particularly in the metropolitan area, and having in his official position peculiar facilities for making himself acquainted with this class of buildings, what had run through his mind in listening to the authors' valuable papers was this, that there must have been gross mismanagement on the part of those who were responsible for the erection and supervision afterwards of the buildings in question. It was a very well-known fact, at all events in London, that there were a large number of buildings that were paying from four to five per cent. per annum. He had been architect for several, and he knew of whole streets of houses of the artizan class which had been built by a builder for investment, and who had for many years derived a fair income of from six to seven per cent. per annum from them. The whole matter, however, depended upon management, if these places were allowed to get into a culpable state of neglect and consequent dilapidation, they, of course, could not pay. It must be borne in mind that if rentals in the future became excessive the workmen were creating that excess for themselves. It was quite possible a few years ago to build for something like ten per cent.—perhaps fifteen per cent. even twenty per cent.—less than it was at the present time. If the workman indulged in strikes, if he put as much difficulty as he possibly could in the way of his employer, if a sympathy and confidence between capital and labour was lost, as it was at the present time, it must be expected that the cost of building operations would necessarily be enhanced and increased in cost, with the natural result that the workman had to pay so much more rental for his dwelling. He maintained that if the artizan caused the evil it was only a just retribution that he should suffer for it. It was not for him to complain of a result which he had himself occasioned. He (Mr. Collins) was indeed much opposed to corporations and

EXAMPLE A.

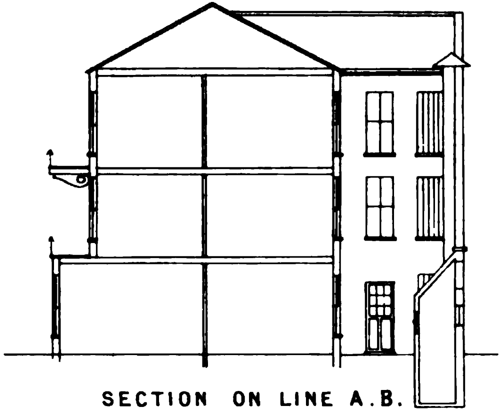
WORKMENS DWELLINGS.

THREE ROOMS ON EACH FLOOR, FORMING ONE DWELLING.

1863.



FRONT STREET.



SECTION ON LINE A.B.

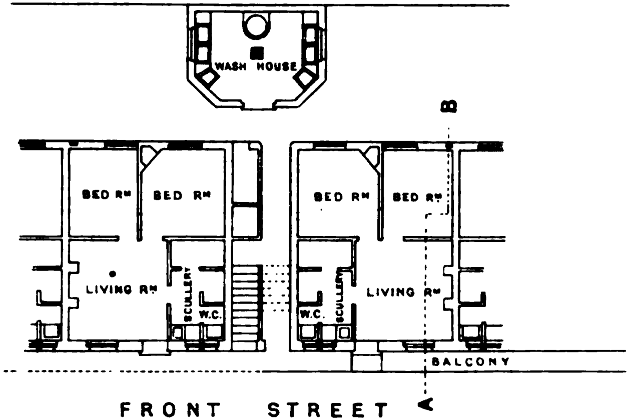
SCALE OF 0 5 10 20 30 FEET

EXAMPLE B.

WORKMENS DWELLINGS,

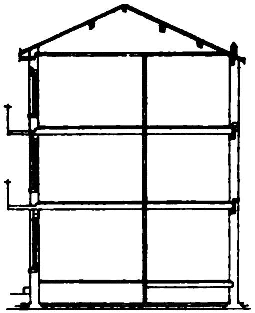
FOUR ROOMS ON EACH FLOOR,
FORMING ONE DWELLING.

1865.



FRONT STREET

SCALE OF 0 5 10 20 30 FEET



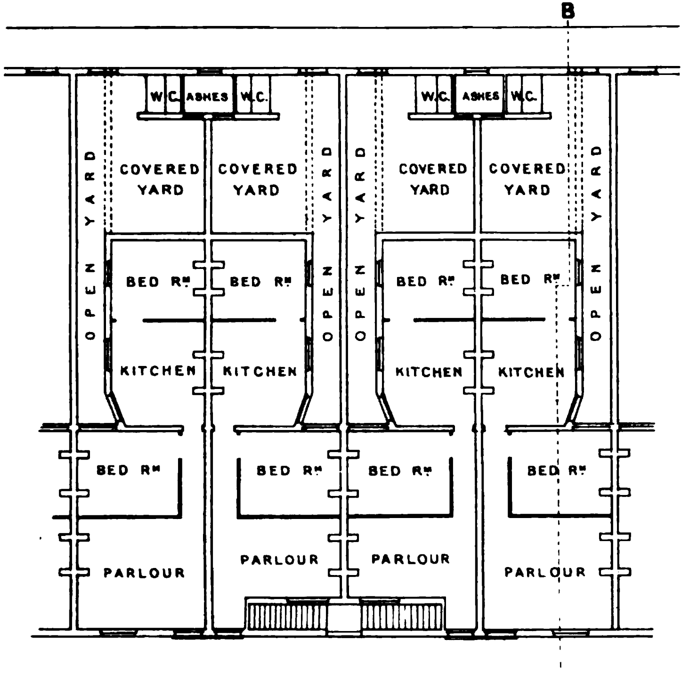
SECTION ON LINE A.B.

WORKMENS DWELLING'S.

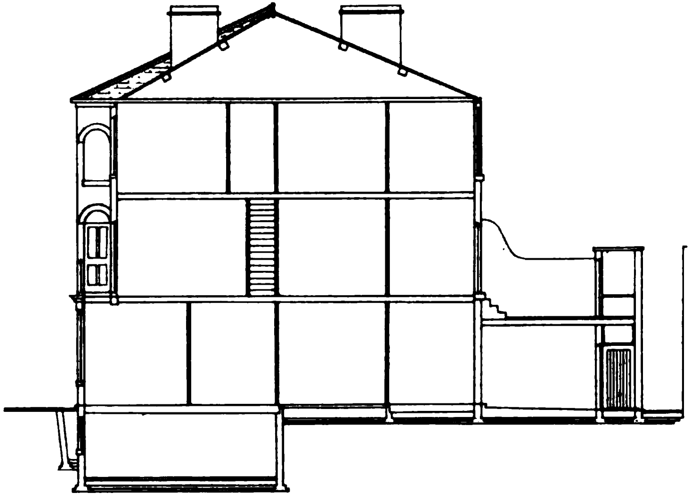
EXAMPLE C.

FOUR ROOMS ON EACH FLOOR,
FORMING ONE DWELLING

1867.



FRONT STREET.



SECTION ON LINE A.B.

SCALE OF 0 5 10 20 30 FEET

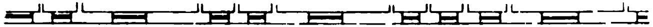
EXAMPLE **E**

[illegible]

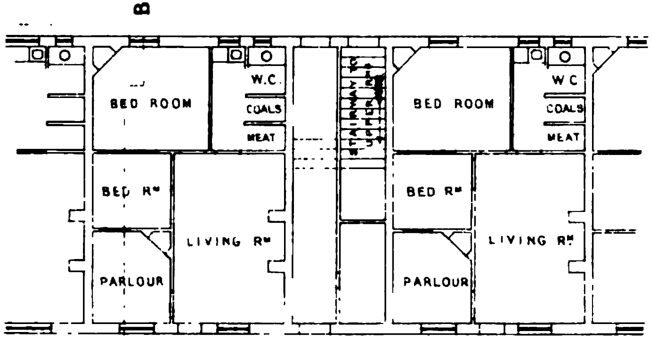
FIVE ROOMS ON EACH FLOOR

FORMING ONE DWELLING

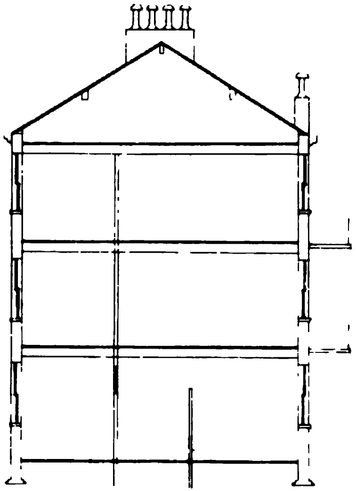
1869



OPEN SPACE AT REAR



FRONT STREET



SECTION ON LINE A.B.

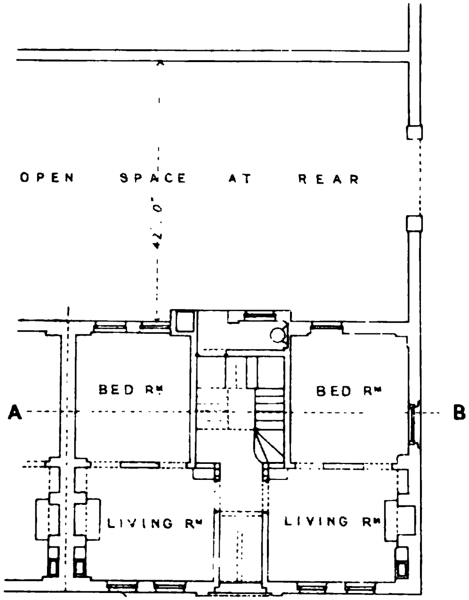
EXAMPLE G.

WORKMEN'S DWELLINGS.

TWO ROOMS ON EACH FLOOR.

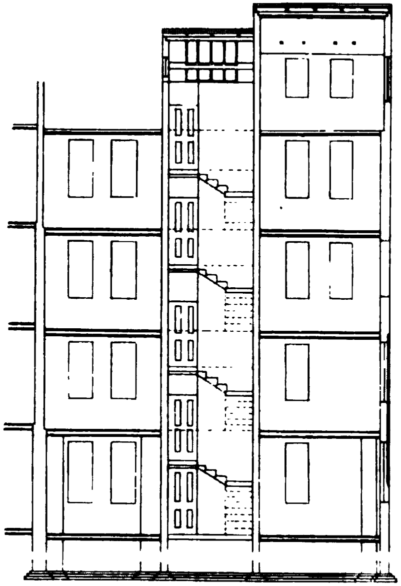
FORMING ONE DWELLING.

1887



Ground plan of one block: all other blocks the same

FRONT STREET



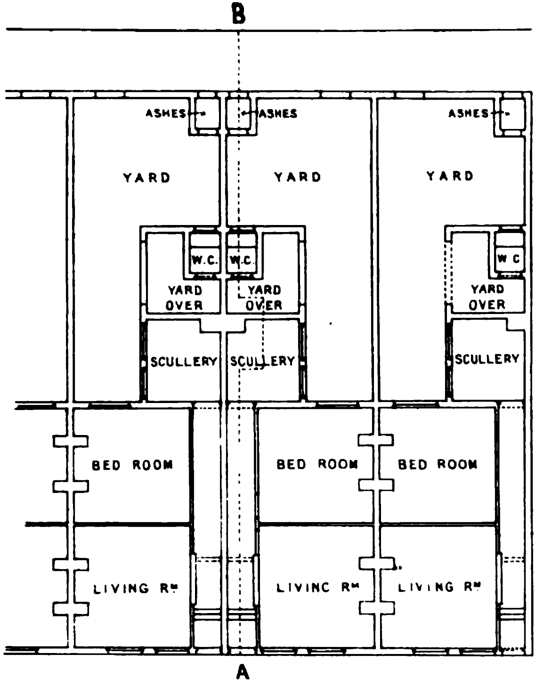
SECTION ON LINE A.B.

SCALE OF 0 5 10 20 FEET

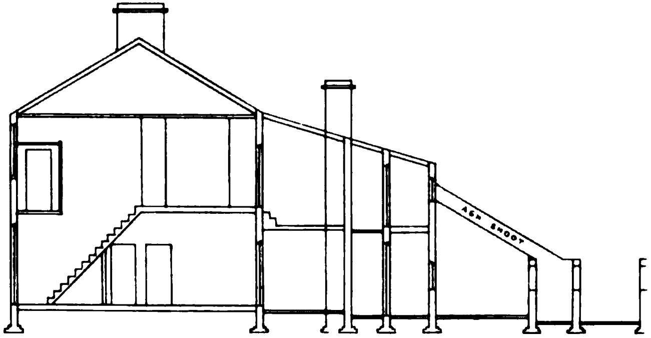
THREE ROOMS ON EACH FLOOR

FORMING ONE DWELLING.

1893



FRONT STREET



SECTION ON LINE A.B.

SCALE OF 0 5 10 20 30 FEET

municipalities encouraging an absence of thought and judgment and a lack of good feeling on the part of workmen, and placing themselves in unfair competition with private individuals by accepting low and unremunerative rents. If that method of procedure was persisted in it would create an evil which one day or another they would all rue. The Rothschild Buildings in the City of London were paying 4 per cent. per annum on the capital invested, and the East London Dwellings Company also paid that amount. Both Companies were considerably enlarging their building operations.

Dr. **Sykes**: Out of Capital?

Mr. H. H. **Collins** (London): The Rothschilds are not the kind of people to pay dividends out of Capital.

A **Member** expressed doubt as to 4 per cent. being paid.

Mr. H. H. **Collins** (London) said the gentleman need not shake his head, as he knew the dividends were paid at the rate named. Mr. Vigers, the eminent surveyor who acted for the Peabody fund, had informed him that the result of his calculations as to the lowest price the Trustees could afford to let the rooms in their buildings, was 1s. 10½d. per room, but then it must be remembered that this philanthropic body was content with 3 per cent. return on the capital invested. In Islington there were six-roomed tenements, and tenants paid for the same an average of 7s. 6d. per week for 3 rooms with scullery and other accommodation complete. The owner of these tenements made it a condition that in the event of damage being done and due notice being given to the tenants, a recurrence of same would determine the tenancy; the result being that the tenants were as careful as the owner, and the property was kept in good condition. The owner had found that his expenditure for repairs was normal and only such as he reasonably could have anticipated. The same gentleman was now expending under his (Mr. Collins') direction a very large sum of money in the construction of similar buildings, and considered it was a good investment of his capital. His own experience was that if the construction of this character of houses was economically considered and properly managed when built, there was no difficulty in making them a fairly remunerative investment. In consequence, however, of municipalities, corporations, and other public bodies being allowed to borrow at very low rates of interest, and being satisfied with totally unremunerative returns, they were enabled to let their property (or rather the ratepayers' property) to a lower class of people at unproductive prices, which proved a great deterrent to private enterprise, and prevented it from entering into useful competition so as to supplement public and philanthropic effort in this direction.

Mr. **Coard** S. **Pain** (Liverpool) believed in philanthropic effort decried by the previous speaker. He was sorry that the experiment of tenement houses had failed, and he could not believe that the result had been brought about by the structure. He thought it was rather due to management. They should instil into the people habits of cleanliness and order, which would do more for them than any Corporation in the world, so that the work of the Corporation must go hand in hand with the efforts of philanthropists. Referring to statements he had heard at meetings of some of the Conferences, he considered them retrograde rather than in advance in the matter of sanitation. He was greatly astonished to hear in one department—he would not mention names—that it was actually suggested that back-to-back dwellings were approved and adopted; and he hoped the impression would not go forth that any members of that Institute upheld such a plan. In another department, what he considered one of the most foolish of all systems, viz., slop closets, was strongly advocated. Now they came to a new phase, namely, that people were to live in one room.

Dr. **Sykes**: I did not intend it.

Mr. **Coard S. Pain** was sorry if he had misunderstood him. He understood him to say that persons should sleep in the same room in which they lived.

The President of the Section (Mr. G. F. Deacon) said the suggestion of Dr. Sykes was that in extraordinary cases they might live as many in a room as Scotch people did.

Mr. W. **Spinks** (Leeds) said he quite agreed that it should not go forth to the public that back-to-back houses were the best type of house for working men. He thought it was a great scandal that 800 of these houses were erected every year in Leeds alone. All the weight of evidence they had was entirely against the continuance of the system. He thought it would be an excellent thing for that Congress to pass a resolution condemnatory of them.

The President of the Section (Mr. G. F. Deacon) said, as a former Municipal Engineer and Building Surveyor of Liverpool, he had felt peculiar pleasure in listening to the papers before them. It was obvious that a very great deal had been done in Liverpool, but much still remained to be done. His principal object in speaking now was to throw any weight he had, or might have, against the idea which was still prevalent in some quarters, that so-called back-to-back houses could be built in a way which would render them satisfactory to modern sanitary ideas. He was perfectly satisfied that it could not be done.

Mr. P. **Fyfe** (Glasgow) said Mr. Goldstraw had stated that Liverpool was a town which had exceptional powers from Parliament as to the erection of dwellings in connection with open spaces behind the dwellings; but he would like to inform the Congress that Glasgow obtained very considerable powers of a similar nature in a late Act, entitled "The Glasgow Buildings Regulation Act, 1892." In their 1866 Act, the free space in front of every window of any sleeping apartment at the back of a building had to be equal to at least three-fourths of the height of the wall in which the said window was placed, and such space had to be measured in a straight line from, and at right angles to, the plane of the window. It was found, however, that builders, under this clause, could occupy the same free space for the sleeping apartments of the building behind it. This had been amended by the Act of 1892, and now each building must have a free space *of its own* equal to three-fourths of the height of the wall of the said building; so that now no building four storeys in height, or say measuring 40 feet from the level of the street to the ceiling of the highest habitable room, could be erected within 60 feet from a similar building in front of it.

Mr. W. **Goldstraw** (Liverpool), replying to the discussion, explained that the regulation in the Liverpool Bye-Laws as to Open Space, required that the distance measured from the back wall of a house to the opposite property—meaning, in the case shown, the yard wall of the other house—shall not be less than the height of the back wall, so that the line at an angle of 45 degrees has to be taken from that point, and the house must not rise higher than that line; therefore, in this case, the distance across is not to be measured from building to building, but from this building to the curtilage boundary of the other property. He wished to acknowledge the very valuable service which Sir Francis Powell rendered to Liverpool on the Parliamentary Committee when their Bill of 1889 was before it. The help given to them by Sir Francis was most important; and it was very proper that Liverpool should on that occasion acknowledge with gratitude what he had done for the community. With reference to the remark that was made questioning the accuracy of his statement, that although during thirty years the Corporation had dealt with only 4,000 insanitary houses, and there still remained 14,000 to be dealt with—his hope was that in the next thirty years they might all be cleared away—he maintained that his figures were quite reliable; and he repeated that it might be expected that, during the next thirty years, the remainder would be "cleared away by the action of the Corporation combined with the forces of natural decay and of lawless destruction,"—meaning that those not pulled down by the Corporation would have fallen to pieces naturally, or would have been demolished by the rough people of the neighbourhood.

Mr. H. P. **Boulnois** (Liverpool) said of course it was a very difficult problem as to how these houses of the working classes were to be managed. It was almost a political question. It was possible that as they had State-aided education, they might have to have State-aided habitations, and that might be the only solution of the question. With regard to the standard of one shilling per room, that he had arrived at simply upon the wages of these classes, and as to what they legitimately could afford to pay in rent. He said that one shilling per room was what they ought to pay, and what they ought to try and achieve. With regard to the remarks of

Dr. Sykes, that they were bound to build on the block system in London, he asked, who was to build them there? Certainly not a private individual, although Mr. Collins told them that certain of these houses had been built privately and paid seven per cent. He had heard it stated on reliable authority that the same class of buildings, such as Mr. Collins mentioned, were absolute sinks of insanitation. He (Mr. Boulnois) had seen some of these blocks with absolutely no light in a room, and the tenements were so close together that the people could shake hands out of the windows. Dr. Permewan had asked a question as to why they did not put the Artisans' Dwellings Act in force in some of their districts. In reply he would say that they found it was better for the ratepayers and equally good for the districts in question, that they should go on in the way they were doing; for if they condemned a whole block as insanitary they had to pay compulsorily under the Act, and the compensation that had to be paid for valuable property, such as public-houses, made the cost enormous to the ratepayers. It was not fair to the present ratepayers that they should have to bear the burden to that extent. They believed they were dealing with the houses very fairly in the way they were doing. In conclusion, he would only add his absolute condemnation of back-to-back houses.

On "*The vital difference between well managed and neglected Sewage Farms*," *by* LT.-COL. ALFRED S. JONES, V.C., ASSOC.M.INST.C.E.

(FELLOW.)

THE subject of this paper has been pressed upon the consideration of the Local Government Board by experts for many years, and has been frequently referred to by its inspectors at public enquiries into schemes for sewage disposal works all over the country, but neglect is still common and deserves condemnation by The Sanitary Institute.

It appears to the author that Local Authorities are generally desirous to do their best in conducting a new business, but that they lack skilled assistance, and drift into neglect from a notion that a sewage farm can be managed by anyone who has worked in ordinary agriculture.

They fail to recognise the fact that all the uncertain conditions with which a farmer has learnt to deal are complicated in the highest degree by the stream of sewage which has been artificially brought to his land in a system of pipes and carriers —a stream which should be dealt with hour by hour as it comes.

Dealing with it properly means spreading it over sufficient and not too much land, so that motion is kept up *continuously* until the water has been evaporated, absorbed in the pores of the soil, or run off purified into a stream.

Simple as this may sound it is not so in practice, and cannot be attained by the observance of any fixed rules, or without the exercise of intelligence of a high order and experience, first by the manager, and secondly by the labourers required as watermen.

The manager must arrange his crops in such manner that a sufficient quantity of land may be always in a fit state to receive the sewage without injury at any rate, and must again exercise his judgment how to utilize that land to the best advantage from day to day under the varying weather, and more or less rapid removal of crops, which may *in fact* correspond with the anticipations on which his cropping calculation was based.

The author has known Farm Committees to impress upon their managers the duty of making the growth of crops a secondary consideration, to be sacrificed on any emergency to the primary sanitary object of maintaining a purified effluent. But on a properly managed sewage farm such an emergency should never arise, and it is invariably the result either of neglect or of insufficient land.

The issue of such instructions is a cowardly defence on the part of Committees against possible suspicion that they are capable of neglecting their primary duty in order to save their reputations as guardians of the public purse, and it ends in their being guilty of mismanagement sanitarily and economically, by setting up a ready excuse for their own errors and those of their subordinates.

Sewage farming does not differ from any other business in the general principle that every detail is important, and that excuses must not be found for the lapses from duty of employés, but that principals must exact the utmost possible results in efficiency of the whole business, taking care to supply the best tools to every hand employed.

Some larger towns have been served by self-educated managers, well supported by their Sewage Farm Committee, when it included among its members some enthusiastic gentlemen like the late Dr. Alfred Carpenter, of Croydon, whose talents and influence supported the manager's applications for plant, live-stock, and necessary labour, which will at once suggest themselves as essential to success.

But more commonly the bailiff or manager has to deal with a committee whose members, having expended all their borrowed money, want the farm starved in working capital, and carried on with the least possible charge on the rates.

In order to fall in with these views of his masters, who send him an abundant stream of sewage to be got rid of, the bailiff's first thought is to save trouble by letting the nasty stuff form ponds on some of his land, from which as much as possible may evaporate in fine weather, and be washed off in wet weather into ditches and watercourses at times when the latter are turbid enough to smother his sewage and conceal it from his neighbour's observation.

He grows a little Italian rye grass to keep up appearances and deluges it with sewage, when it has grown a foot high, to ruin green fodder which ought to have been cut and disposed of at proper times, and cultivates the rest of his land as his neighbours do in ordinary farming.

The weeds grow apace wherever the stagnant sewage reaches, and he is forced at last to spend more in labour for cutting and destroying them than would have cut and sent to market valuable crops if labour had been available at the right time. Or he takes in horses and cattle at ley to eat and tread the long grass, which he has neither labour to cut, nor animals tied up to consume what he cannot sell off the farm.

The Farm Committee, knowing the rate of labour per acre average for the district, strive to keep their bills down nearly to that standard, and fearing the risks inseparable from live-stock keeping, refuse to provide trading capital for that often necessary branch of their business.

The Engineer who laid out their farm has often foreseen that necessity, and provided buildings for the purpose; but the borrowed capital account is closed, and the Committee leaves the buildings tenantless rather than throw the burden of live-stock purchase on a single year's rate.

In fact our practice, for the last thirty years, has been to employ a civil engineer to "lay out" an area of land with carriers and sluices, roads, &c., according to a hard and fast plan, pay him off with borrowed money, and place the whole complicated machinery in charge of a bailiff, imbued with all the prejudices, and subject to the jealous contempt of his class when he meets it at market, after undertaking to serve a public body in the capacity of a degraded scavenger. He has often been nearly worn out with manual farm-labour, and looks for an easier future in helping his new masters to make things pleasant in their new fad of sewage at the outfall, and to show effluents rather than to educate himself and others by hard work and ceaseless anxiety.

It would be invidious in a paper like this to single out particular instances to exemplify the author's meaning, but they are very common, and he has always found that bad effluents and low financial returns go together; so that it seems worthwhile for the ratepayer to give his attention to the subject before things become so bad that injunctions and prosecutions are undertaken against badly managed sewage farms.

It has often occurred to the author that one or more of the best managed sewage farms should provide opportunities for the education of managers and "watermen," and keep a register from which qualified men could be supplied when wanted by other farms.

For proper sewage farming is still in its infancy, and the science of irrigation is very backward in this country, where people do not recognise the extent to which it is susceptible of improvement.

One must go to India or Egypt to see each plant supplied with the water it requires, and not an overdose; and our irrigation engineers have found in those countries populations ready educated in the detail work of distribution by the spade which can alone secure a proper return for the larger engineering works, while our agricultural classes are skilled in under drainage works for removal of superfluous water, but know nothing of supplying water to the plant.

Difference of climate, of course, accounts for that of practice, because, in the simple natural course of agriculture, the English drainer is often required; and on the other hand, the Indian coolie has often to lift from wells sufficient water for any crop, and naturally economises the fluid which has cost him labour in lifting.

He knows that the more rapidly he runs the water to the roots of his plants, the less will be lost by evaporation, &c.

Sewage farming, however, is an artificial condition, rendered necessary by sanitary reasons, and, in our soil and climate, generally requires the united exertions of the English drainer and the experience of the Indian coolie, besides that of an English farmer of the most enlightened kind, free from the common prejudices of his order.

That the combination required has been attained in different parts of England and Europe has been abundantly and officially proved, and it seems unnecessary to make long citations in proof of such a proposition.

It may, however, be worth while to state the author's personal experience as briefly as possible, as follows:—

It was his mission for nineteen years (1872–91) to deal with all the sewage of about 12,000 persons at Wrexham, on 84 acres, latterly extended to 150 acres, of good land, under physical circumstances involving the passage of every drop of the sewage not evaporated into the river Dee above the intake of the Chester Water Company.

Under such circumstances his operations were closely watched by the Corporation of the City of Chester; and the financial accounts of the farm for the first seven years were accurately recorded by the Sewage Farm Prize Judges, 1879, in their report published in the Journal of the Royal Agricultural Society of England for 1880.

Six out of those seven were normal years in English agriculture, but the seventh (1879) was a specially bad one, but the annual profit was quite satisfactory after paying the exceptionally high average rate of £5 per acre for rent, taxes, and sewage.

The well-known agricultural depression of the twelve remaining years of the author's tenancy was met by no reduction on that liability, and on closing accounts in February, 1891, the author nevertheless found a respectable annual profit had been made on the average of the term of nineteen years.

And the record of that balance of receipts and expenditure for the whole nineteen years is unquestionable, because the *auction sale* of remaining farming stock therein took the place of *estimate* of value at the end of each of the several years in the published accounts of the first seven years.

Knowing all the impediments in the way of a successful introduction of an innovation upon ordinary agriculture during a long period of depression and frequent wet seasons, the author often reflects with surprise that sewage farming has so thoroughly established itself in the opinion of the Local Government Board and others, as the best means of sewage disposal, and he can understand a certain amount of apathy which has arisen in public opinion as the reaction from the over-estimates put forward by enthusiasts who advocated the introduction of that innovation in past years.

He never belonged to that sanguine class, but was always a believer in the powers of nature by which organic débris can be transformed into healthy living matter, and in the duty of man to facilitate the natural circulation between dead and living matter, which has been hindered ever since his gregarious habits led to the building of cities.

But in these days no great reform is attained without popular demand, and it is to be hoped that some effort may be made at this Congress to draw the attention of ratepayers to their interest in the subject of this paper.

Major **Lamorock Flower** (Lee Conservancy Board) said that the treatment of sewage by land was practically the only way of getting rid of its impurities before it was admitted into a river—at least, one out of which people drank. Colonel Jones at Wrexham some years ago performed an operation of great practical value. He planted a belt of his land with osiers, which were great factors in getting rid of impurities, which they sucked up. So that it was important to lay out a certain area for osier cultivation. It was also necessary that every effort should be made to get rid of the foulness by sewage which was to be seen in certain rivers. And as regarded the utilization of sewage on land, they were all glad when it paid its way to a certain extent.

Mr. **Harrison Eddy** (of the Sewage Department of Massachusetts) stated that he was connected with works, where they dealt with 13,000,000 gallons of sewage daily, and he thought the question of proper management was exceedingly important. The prime object of such treatment was to dispose of the sewage, and not to get a return for it. The method which they had adopted at his works was that of chemical precipitation. The point was to have the works managed by a man who could do it from a theoretical and scientific standpoint. That was to say, there should be an active and well educated chemist who should have charge of the work, and that to get the results, analysis should be made every hour in the day, every day in the week, and every week in the year. In that way they could find out exactly what they were doing, and they could tell the sanitary bearing of the process. He was sorry to say that he had been unable to obtain any such result from any process. It was very easy to treat sewage for a few days, but to treat it day after day, year after year was another matter. At his works they took a sample of sewage and a sample of effluent once an hour during the twenty-four hours. They were in proportion to the volume of the sewage and the volume of the effluent. The twenty-four were mixed, making one of the effluent and one of sewage. This was examined by a chemist and biologist, and in this way they knew what had been done in the twenty-four hours. Looking at the water through a certain depth, if he could not see the bottom of the basin when the sun was shining, in 6½ ft. of water, he asked the foreman what was the reason. He would not say that the water was pure but the chemist called it good water. Mr. Eddy urged that they should carry on the work in a scientific manner, and with thoroughly inexhaustible research.

Mr. C. H. **Cooper** (Wimbledon) remarked that the discredit brought on many sewage farms throughout the country was due to the management and laying out of the ground. In the majority of sewage farms only a portion of the ground could be irrigated, as the surface had not been levelled. Where the surface was not level, sewage stagnated on the lower portions, and prevented crops growing. If money was not spent in levelling the surface properly the result was a constant expenditure out of rates. He thought it was a great pity that in the management of sewage and sewage farms the aid of the chemist was not called in oftener. He wished that he could have a daily or even a weekly analysis made of sewage and effluent, for then there would be a record of what actually took place. If proper analyses were to be made, they ought to be done by some other body than the Sanitary Authority. With a proper record of the work done in each particular sewage treatment, there would be some evidence of what was really the best chemical treatment, whereas, at present the only evidence that could be got was from the promoters of some of these several schemes.

Mr. **Denham** (Tadcaster) said he quite agreed that sewage farming grew a considerable amount of weedy rubbish, and his experience was that land irrigation pure and simple was not a good treatment. They did not cultivate the ground, and it got choked up with sewage. Instead of having a farm from which they could get good crops they were nearly always poisoned with the stink of the sewage. He found downward filtration coupled with land irrigation useful, and by this method he had a farm now cultivated with rhubarb within eighty yards of a terrace of good houses, which had been working for over seven years yet no complaint as to effluvia had been made. By taking out the solids first they to a great extent stopped the nuisance; but if they turned the sewage straight on to the land they would nearly always have it covered with weed instead of grass.

The President of the Section (Mr. G. F. Deacon) remarked that he had read with the greatest interest and profit much that had been said in connection with filtration in America, and he quite agreed that it was very desirable that they in England should emulate Americans in the matter of exactness and close observation of what took place, and the application of some scientific methods to the daily management of filter beds.

Lieutenant-Colonel A. S. **Jones** (Carshalton), in replying on the discussion, stated that his object in reading the paper was to excite attention to the matter of having works already in existence all over the country properly attended to, instead of their being absolutely neglected as they were now, generally speaking. He believed in no one system for general application. Where they could not get land at a reasonable price and suitable, they must resort to clarifying by precipitation. He considered that the Americans had taken up the subject in a truly scientific way. Whereas, the English engineers and inventors had been empirically jumping to conclusions from a few slight experiments. Americans had set us a grand example in the way in which they had tackled the subject. If they took any bottle of natural sewage, agitated it sufficiently, and then set it down to rest for 20 minutes, they would have a very considerable precipitation, without the expense of any chemical agent. He would recommend clarifying the sewage in some cases before putting it on the land; he was of opinion that any clogging of the land was absolutely due to neglect of the proper management.

Mr. H. EDDY (Worcester, Massachusetts) explained that he did not wish to put forward any of their American methods or to make any criticism or comparison between the American and the English systems. He came there simply to learn.

On "Willow Farming as a profitable means of utilizing Sewage Effluent," by ARTHUR KENT.

(ASSOCIATE.)

ALL new schemes are generally considered from their practical utility and commercial value points of view, and in all suggestions on the treatment of sewage they are essentially the main features. It has been said that "All the thoughts of men, from the beginning of the world until now, are linked together in one great chain." We do know that all the works and thoughts of sanitarians, whether medical, chemical, engineering or building, are linked together for the sole purpose of making the lives of those who dwell in the civilized portion of this globe as happy as possible.

In times gone by, when sanitation in this country was practically in its infancy, dwelling places were surrounded by stinking middens and cesspools which were emptied occasionally, and perhaps not; these accumulations of filth with their foul emanations, were the glory holes of those disease germs which brought sorrow to many a household. But now we live in a more enlightened age, and instead of being continually worried by overflowing cesspools, stinks and disease, the average householders have only to pour their slops and refuse into drains which run into sewers provided by their sanitary authorities, and the authorities do the rest.

These words "The authorities do the rest" constitute the text of this paper. Since it became lawful for house drains to be connected with public sewers, and especially since water-closets came into use, town sewage has increased and become the source of endless experiments and research, both engineering and chemical, to discover some practicable, cheap, or profitable method of disposing of immense volumes of effluent in such a manner that no nuisance shall arise to cause discomfort to the community.

The crude sewage is generally first precipitated, and the remaining partly clarified liquid disposed of by broad-irrigation or intermittent downward filtration on cultivated land. I now wish to point out a practical and profitable method of disposing of this effluent by farming Willows.

Willows, botanically, are the Salicineæ order which includes the genera Salix and Populus; the former being the more common. There are over two hundred species of the Salix family which are divided into three groups, Osiers, Sallows, and Willows; they all belong to temperate and cold climates and consequently may be grown with good results in this country. Apart from the sentimental aspect, as being an emblem of despairing love, they possess numerous qualities and uses of considerable commercial value. Some are valuable for their timber for making boxes, surgical splints, and fancy articles of furniture; the young shoots furnish material for hoops, crates, and baskets. In Northen Europe the bark is used for making mats, very similar to cocoa-nut matting. In Tartary the woody fibre is macerated in water or chemical solutions, separated and spun into thread from which cloth is woven. Willow charcoal has long been famous for its important medicinal properties, and it has been proved to be superior to the charcoal procured from most trees for preparing gunpowder. The bark of all the species contains tannin, the Salix Russeliana containing as much as the Oak.

Medicinally, the bark possesses astringent, tonic and febrifuge qualities, rendering it a valuable substitute for Cinchona, and as Cinchona is becoming scarce, willows have a wide field open to exercise their virtues. The chief drugs prepared from the bark are Salicine, which is equal in many respects to quinine, Salicylic acid and Salicylate of sodium. They have become very popular in medicine as remedies for rheumatism and influenza; and the acid and its sodium salt are very valuable antiseptics, having stronger action on some forms of bacteria than carbolic or boracic acids. Unfortunately the pure natural drugs are far too expensive for general use, and refuge is sought in the artificial acid and salt prepared from carbolic acid, caustic soda and carbonic acid, with the result that, on account of the unsatisfactory results of using the artificially prepared drugs, medical practitioners are beginning to look with disfavour upon the merits of the natural drugs. If, therefore, willows were cultivated in this country we should be able to compete with the German druggists and introduce cheap, reliable, and very important drugs, and let our suffering community have remedies which will not produce so much of the sickening giddiness and delirium as the artificially manufactured articles.

In cultivating willows one of the first points to be considered is the determination whether the plant is male or female. Male flowers have from one to thirty distinct monadelphous stamens, whilst the female flowers have a superior one called ovary, and numerous erect ovules. The female is the more vigorous growing plant, consequently where timber, or coppice wood, hoops, or rods for coarse basket making are required it should be selected; on the other hand, when tough and delicate rods for the finer kinds of wicker work are required, the male plant ought to be selected. All willows that are intended for basket rods, hoops, poles, or timber trees should annually ripen their shoots. Hence the colder the climate, the drier should be the soil, but wherever planted they should be within reach of water. Low moist bottoms, high banks of rivers, brooks or ditches, are the best situations for them, but care should be taken that the soil is drained, for although they require much moisture they will not grow in constantly damp places. Great care is required to produce willows and osiers in perfection for basket rods and hoops, they may be propagated by cuttings, but some species will grow from seeds, and probably they can be grafted as easily as other plants.

To procure artificially the natural requirements of willows I have designed a bedding place (diagrams of which were exhibited) to filter sewage effluent in such a manner that willows may be grown to absorb a large quantity of the liquid, and at the same time thrive. The bed may be square or oblong, the size being regulated by the quantity of sewage to be disposed of, and is surrounded by an embankment on which the trees are grown; inside this boundary there are alternate rows of gutters for the effluent, and embankments for the willows; the width of the gutters should be about 6 ft. and nearly double the surface of the embankments. The gutters are laid with some pervious material such as iron grating, perforated stone flags or stones laid a little distance apart so as to permit the liquid to percolate slowly, and so that, during the resting time allowed between each discharge of effluent, they may be used as a pathway for the purpose of examining or gathering the wands, without having to tread a boggy mire. The effluent is discharged from the tanks through pipes having a projecting outlet at the end of each gutter, and by this means all the tanks may be emptied and the gutters filled in about eight hours' time, then a rest of sixteen hours will ensure complete percolation and guard against continual saturation of the soil. Six feet below each embankment ordinary agricultural drain pipes are laid to drain away the unabsorbed filtered liquid.

The planting of the species of the willow family known as osiers and especially intended for wicker work, is an exceedingly simple matter. Live or quick plants are cut into stakes or truncheons, one end of the cutting is sharpened and the pointed end thrust into the ground in a standing direction. The cuttings are placed about a foot apart and a crop is obtained in the third year, the canes continuing to bear for the next ten or twelve years, when replanting is necessary. Those intended for the finer class of white wicker ware must be cultivated close together, so that the parent cutting, instead of developing into a bush-like growth, sends up straight and tapering canes. The wands must be cut after the early winter frosts whilst the sap is not circulating, and then placed in trenches of water and allowed to remain till the advent of spring when they commence to sprout, they will then peel readily. In America the wands are taken immediately after cutting to hot-houses and sweated, which soon makes them ready for the peeling machines. The coarser rods are simply stacked and protected from damp and used as required.

Hampers, baskets, and all kinds of wicker ware are in constant demand, but for want of the raw material, basket making is not, comparatively speaking, an extensive industry in this country, consequently foreign made articles are imported, and money which would otherwise remain here, is constantly flowing into the coffers of our foreign commercial rivals.

Calculating roughly, the value of peeled delicate willow wands is 3d. per pound. If the salicine is extracted from the bark, the value of the crude wand is considerably increased; and after deducting the cost of planting, cutting, and preparing, there would be a net profit of quite 2d. per pound for the young shoots. If the willows were allowed to grow to maturity their value would be augmented by the timber, either for use for making boxes or charcoal.

Salicine can be prepared from the bark peeled off the shoots by exhausting with boiling water, concentrating the solution, then digesting it with powdered oxide of lead, and then, after freeing the solution of lead by a stream of sulphuretted hydrogen gas, evaporating till the salicine crystallizes out on cooling: and salicine under the influence of a ferment is converted into salicylic acid, and by neutralizing this acid with bi-carbonate of sodium the salicylate of sodium is obtained.

By the extensive cultivation of willows it is obvious, that not only are immense quantities of sewage effluent absorbed, but it is a very profitable and easy method of disposing of the effluent, besides furnishing commodities for home industries, and thereby introducing, more extensively, an employment for many of our countrymen to enable them to compete favourably with foreigners, diminish the present stagnation of commerce, and help to check the painfully increasing pauperism of this country.

The **President** of the Section (Mr. G. F. Deacon) said that one of the reasons why willow culture should be encouraged as much as possible was because it gave employment to a large number of women in basket making, &c. It was an operation which could be performed without difficulty by women, and perhaps to that point some of the speakers might address themselves.

Mr. S. S. **Platt** (Rochdale) observed that it was not a new idea to advocate the drainage of osier beds, but he always understood that it was useless, as the drains were very soon filled up by the root fibres of the osiers; and his experience of osiers was such that he should not recommend them for treating sewage. They might do for sewage effluent, but they certainly would not do for sewage. The Mersey and Irwell Inspector had suggested to him the abandonment of the osier bed altogether, as unsatisfactory for sewage purification.

Mr. C. H. **Cooper** (Wimbledon) said that in the case of effluents, which wanted a final cleansing, osiers certainly formed a very good crop, but crude sewage could not be treated on ground covered with osiers, except in country districts where far removed from houses. As regards the price of osiers it varies very considerably. Last year it was exceptionally good, while for several years before it was almost impossible for them to sell osiers about London.

Mr. **Charles Burt** (Richmond, Surrey), said he believed that osiers had been grown for some time at the sewage works at Dorking, but that the Engineer found they did not answer, and he had to change the system of dealing with the sewage. At the same time, he thought it was possible to treat sewage as suggested in the paper, what was unsuitable in one place, might be suitable in another, and it was desirable to have as many ways of dealing with it as they possibly could. With regard to the chemical constituents of the willow, it was very nice to hear how many useful and valuable products could be obtained from it; but he did not think one should, practically, attach much importance to this. When they could employ blind people on willow work, so as to get some return for their labour, they would all agree that it was an excellent thing.

Major **Lamorock Flower** (Lee Conservancy Board) said it was a mistake to turn crude sewage on to osier beds, for naturally they turned filthy in a little time. That was an imperfect and irregular mode of cultivating osiers. If they wanted to make osiers useful for sewage treatment they must use the sewage effluents and plant the osiers in trenches some three feet apart. But still it was better to dispose of the sewage and to let the ground be foul than to allow an overflow of sewage from the land into the river. He thought that the paper was very valuable, and that the suggestion for the employment of blind people in manufacturing baskets from the osier was an excellent one.

The **President** of the Section (Mr. G. F. Deacon) said that with regard to their being deterred owing to the fear that the price of a thing might be brought down, he would point out that it would apply to every possible endeavour to improve a manufacture, and if they were to consider the fear that their profits in detail would be reduced by the fact that they had improved the industry, very little improvement would be made in any direction whatever. All these things balanced themselves, and if they reduced the cost of willows they would reduce the cost of baskets; but they would increase the number of persons who got employment in basket making.

Sir **Thomas Crawford** (London) alluded to an instance in which the planting of osiers on a large scale in North-Western India had assisted to stamp out malaria in a notoriously unhealthy valley covered with stagnant pools. The system had proved remarkably conducive to public health.

Mr. A. **Kent** (Darlaston), in reply, referred to the profit arising from willows, and said that the value of the unpeeled willow-wands for basket making was from £2 10s. to £3 10s. per ton, and the annual yield of 20,000 cuttings on an acre of land from 6 to 7 tons. The value of the medicinal salicine extracted from the willow-bark was 9d. per ounce; the value of natural salicylic acid, 3s. per ounce, and salicylate of sodium, 3s. 9d. per ounce: but these prices would be considerably lowered if the drugs were manufactured more extensively in this country. He mentioned the therapeutical actions of the natural and artificial salicylates, referring to the evil effects following the use of the artificial drugs. His paper was in favour of simply using up sewage effluent, which was filtered through the beds, and the unabsorbed liquid run away to rivers or other water-courses by ordinary agricultural drain pipes. He had been surprised to find that on some sewage farms he had visited they knew nothing of willow cultivation.

On "The Purification of Air emitted from Hospitals for the treatment of Infectious Diseases," by WILLIAM HENMAN, A.R.I.B.A.

IN bringing this subject to your notice, I recommend it for consideration by taking as a text the old yet true saying that "Prevention is better than cure," which, if I may be allowed to say so, is the "*raison d'être*" of The Sanitary Institute under whose auspices this Congress is being held.

Before describing in detail an entirely new method which I propose should be employed for the purification of air emitted from hospitals for the treatment of infectious diseases, it may be advisable briefly to consider why it is necessary that air, emitted from such buildings, should be purified, and to examine whether the methods already employed reasonably accomplish the desired end.

Ancient writings, including Holy writ, which alludes to "the pestilence which walketh in darkness," indicate that from very early times a belief has been held that disease is conveyed by the atmosphere; yet it does not appear to have been realised until recently, that disease itself is a source, perhaps the source, from which disease pollution of the air takes place, and, even yet, accurate knowledge as to the extent of atmospheric conveyance of disease is sadly wanting.

Until the contrary is proved, it may be safe to infer that every person inflicted with disease, due to germ life, is a source of contamination to the air around him and a danger to the community.

Fortunately we are assured that the sun's rays and fresh air are fatal to many disease germs, some being more susceptible than others to their influence, which may in part account for the varying degrees of infectiousness attributed to different diseases. It must, however, be remembered that "the pestilence walketh in darkness," that sunlight is not always present, and that without suitable appliances, it is most difficult to maintain air in a constant state of freshness, when a number of persons suffering from disease are brought together.

Moreover, it is recognised that disease germs develope "spores" which are unaffected by influences which would destroy the germs themselves: just as it is possible to kill a bird by means which would not of necessity destroy the element of vitality in the egg it laid.

We are told that disease germs are extremely minute, that they multiply at an enormous rate, and that they, or their spores, are found in the atmosphere, varying in numbers according to proximity to or distance from polluting influences.

If such is the case, it seems, at first sight, strange that any individual escapes disease, but if comparison be again made with an egg, it will be realised that suitable surrounding influences are necessary for the development of vital activity. The history of epidemics indicates that these predisposing influences are developed in individuals by insanitary surroundings. Consequently it appears that two things, at least, are necessary to secure immunity from disease. *First*, to quickly remove all predisposing causes. *Secondly*, to prevent the dissemination of germs or their spores from the infected.

Both are difficult of accomplishment, but year by year advances in each direction are made, so that, notwithstanding the larger and denser communities of modern times, epidemics of disease, in this country at least, are less frequent and more easily coped with than of yore; and inasmuch as leprosy, black-death, and other diseases, which in past times wrought havoc in this land, are now practically stamped out, may not other diseases eventually be eradicated by the employment of suitable means for destroying, and thereby preventing the dissemination of, the vital principles of those diseases?

The isolation of infected persons is looked upon as of primary importance, and as comparatively few homes are suitably constructed for that purpose, hospitals for the collective treatment of cases are provided, yet it is feared that danger, not so much to one another as to those who dwell around, results in bringing together so many infected persons.

The evidence given before the Royal Commission on fever and small-pox hospitals in the Metropolis in 1882, leaves no doubt on that point as regards small-pox, and, some doubt as to other diseases.

A ray of hope, however, is emitted by the evidence of Dr. Burdon Sanderson, "That hospital wards might be so constructed as to enable the air after it has been passed through the hospital, to be subjected to a high temperature or some other means of destroying whatever dangerous properties it may possess before it is discharged."

Surgeon-General Billings pointed out at the time, practical objections to the employment of heat as a disinfector; yet some four or five buildings have been erected in England supplied with furnaces and appliances intended to purify the air *drawn* from them, viz., at Nottingham, Bradford, Barnsley, Blackburn, etc.

Although the wards of these buildings vary in form and the apparatus differs in its arrangement, the principle adopted in each is similar; purification of the air being attempted by *sucking* it through a furnace.

The contrivances are ingenious, and as the purifying effect of fire is well known, it behoves one critically to enquire as to the probable chances of practical success by such a system before venturing to suggest the adoption of any other means.

I therefore propose to apply four tests, viz.:—

1. The cost of the apparatus.
2. The cost of maintenance.
3. The effective ventilation of the buildings.
4. The state of the air discharged.

1. *The cost of the apparatus.*—I find that a furnace was designed for use in connection with a building at the Western Fever Hospital, London, intended to extract from, and purify the air of, two wards, each for six beds, at an estimated cost of £790 (exclusive of any alterations to the building), *i.e.*, at the rate of almost £66 per bed.

2. *The cost of maintenance.*—Each patient was allotted about 2000 cubic feet of space, the air of which ought to be changed at least six times per hour, so that, for twelve beds, not less than 3,450,000 cubic feet of air would have to be extracted and purified every twenty-four hours. I am informed that the mere passage of air over metal plates maintained at a red heat would not insure the destruction of all germs; and it is a question whether, if the whole volume of air were raised to even 212°, or say 150° above the normal temperature, the germs would with certainty be destroyed. There are no reliable data on which to calculate the actual consumption of fuel which would thus raise the temperature of so large a volume of air within the time. Much would depend upon the apparatus employed; but at the lowest estimate some four to five tons would be required every twenty-four hours, or from 1400 to 1800 tons per annum for the twelve beds.

3. *The effective ventilation of the buildings.*—The updraft in the furnace flue is the power by which the air from the wards is extracted, through openings usually placed some feet above the patients' beds. By this system it must be evident that to renew the air it will be sucked from the nearest inlets, probably in direct lines to the outlets; decided draughts will be caused in some parts of the wards, while in other parts, particularly around the patients, comparative stagnation will exist, and there can be no certainty whatever that the air drawn in comes from pure sources, neither can it be cleansed, tempered, or humidified.

At Barnsley gas is employed in "Keeling's Destructors," and I learn there is considerable doubt as to their practical efficacy; also that the air of the wards becomes excessively dry.

4. *The state of the air discharged.*—In addition to the question as to whether the disease germs are destroyed in the furnaces, the large consumption of fuel must necessarily pollute the atmosphere.

Since writing the foregoing I have been favoured with a copy of Dr. F. W. Barry's report to the Medical Department of the Local Government Board on "Certain Methods in use for the Sterilization of the Exit Air from the Wards of Small-pox Hospitals," detailing the results of careful experiments made and concluding with these words:—

"In all the hospitals hitherto referred to in this Memorandum, the action of heat is depended upon for extraction of the vitiated ward air along certain definite channels, and for the subsequent sterilization of this air. At Barnsley and at Nottingham, gas was employed for these purposes, but at both these places the process adopted failed to secure either of these results in a satisfactory manner. At Bradford, where the heat of a furnace was employed, it was found that whilst the process adopted failed to secure satisfactory results as regards the sterilization of the ward air, a considerable measure of success was obtained with respect to the withdrawal of the vitiated air along certain definite channels at the time of experiment when the working of the apparatus was under the careful control of the designers. It is, however, scarcely necessary to point out that quite apart from the question of sterilization, it is essential to the success of any method of artificial ventilation that its action shall be uniform at all times by night as well as by day; and when, as at Bradford, the system is dependent upon the efficiency of a stoker, uniformity in this sense cannot be regarded as secure."

"Subsequently to the observations noted above, my attention was directed to a system of mechanical ventilation recently adopted at the Victoria Infirmary, Glasgow, which was stated to have given very satisfactory results. I accordingly, under the Board's instructions, visited Glasgow and inspected the method of ventilation adopted, in company with Mr. Key, the designer, to whom I am indebted for a description of the system of ventilation carried out by him. This description I append to my Memorandum, since the method would seem likely to lend itself to the purpose that has not yet been fully achieved in regard to the Small-pox Hospitals I have dealt with."

With this I leave you to judge of the practical utility of heat as an air purifier, and turn to a simpler, cheaper, and probably far more effective method, which, by observation and experiment, I believe can be practically applied.

Let me however first mention that in addition to previous knowledge of hospital requirements, I have during the last three years paid very special attention to the subject of Hospital Ventilation, having been entrusted with the erection of the large new General Hospital for the city of Birmingham. After careful enquiry, the committee decided to adopt the method of heating and ventilation devised by Mr. William Key, and carried out by him at the Victoria Infirmary, Glasgow, as well as in several other large buildings. I therefore determined to make myself fully acquainted with all the details, so as intelligently to make every provision in the buildings for the successful working of the methods he adopts; and for that purpose thoroughly examined several buildings ventilated by Mr. Key, as well as others in which mechanical means are employed, and being fully persuaded as to the soundness of his methods, we have provided in the new General Hospital for cleansing, warming, and humidifying no less than 20,000,000 cubic feet of air per hour, and for propelling it to within the buildings, thereby doing away with the necessity for open fires, with their accompanying dirt and noise, avoiding all steam and hot water pipes within the habitable parts of the buildings, and requiring no opening of windows or other means for admitting the outer air direct to the wards or corridors.

An important feature employed by Mr. Key is the air washing screen, which cleanses the incoming air of all dirt and fog, destroys flys, moths, and other insects, and, as proved by careful experiments, entraps a very large proportion of disease germs present in the atmosphere. Experience has also shown that, in consequence of the screen being kept moistened with water, the air is maintained in a proper state of humidity, for, strange as it may seem, the air, in passing through, is moistened when over dry, and dried when surcharged with moisture.

A consideration of what is effected by Mr. Key's screens at the air intake, led me to believe that the outgoing air, after being vitiated by the presence of infected patients, might be again purified by the use of somewhat similar screens at the outlets. This idea I propounded to Dr. G. Sims Woodhead, Director of the Experimental Department of the United Colleges of Physicians and Surgeons, London, who, considering it feasible, kindly undertook an elaborate series of experiments, in conjunction with Dr. Cartwright Wood, to test the efficacy of the means to be employed.

Fever patients are now usually provided for in a series of detached buildings, connected, if at all, by partially enclosed passage ways.

I consider that each block of buildings should be separately supplied with an air-intake, screen, heating coils, and fan, which, in a building of only one storey may be arranged in the roof space.

I take no credit for the method by which a suitable supply of air is cleansed, tempered, humidified, and propelled into the buildings, but am indebted to Mr. Wm. Key for the kind assistance he has rendered in working out my ideas in connection with the methods he adopts. I simply propose that air, so cleansed, tempered, and humidified, be propelled through narrow wedge-shaped openings in the ceilings, and, by means of a simple form of spreader, evenly distributed throughout the wards and corridors.

What I claim as a novelty is the placing of screens (somewhat similar to those employed by Mr. Key at the air intake), one at the *head of every bed*, and keeping the same charged with a disinfecting fluid.

An outlet flue will of course be provided at the back of each screen, so that as fresh air is constantly being propelled into the ward an equal quantity will be forced through the screens, all other outlets being stopped; consequently, almost immediately the air becomes contaminated it will again be purified, *even before it actually leaves the apartment*, and thus purified will pass up the flues and into the open.

A very simple contrivance is employed for keeping the screens constantly charged with disinfecting fluid, so as to obviate disturbance to the patients in the wards, and reduce, to the least possible limits, personal attention. The disinfecting fluid found to be perfectly effective in destroying disease germs is a weak solution of carbolic acid, which fortunately can be used with absolute safety to individuals, and without injurious effect upon the materials and apparatus employed.

Above and below each screen a shallow trough is placed, the upper and lower ones respectively being united by lead piping, carried to any convenient position outside the wards, each connected to a cistern of moderate dimensions to which a small pump is attached, so that as the fluid flows along the upper pipe and trickles down the screens, the surplus is caught in the lower troughs and returns through the other pipe to the lower cistern, whence it is pumped to the upper one. This may be made practically automatic by applying to the pump the same motive power used for turning the fan which propels fresh air into the building, and by having a third cistern or reservoir, with regulated supply to make up for loss of fluid by evaporation from the screens.

As to the efficacy of the screens thus charged, I will read the concluding remarks of the valuable and exhaustive report upon the experiments undertaken by Drs. Sims Woodhead and Cartwright Wood, simply drawing attention to the fact that by the apparatus they employed, the screens experimented upon underwent a far more severe test than they could possibly be subjected to as used in an actual building. These are their words:

"Although in some cases, such as cholera and typhoid, the disease is transmitted directly by the bacillus, in others such as the acute exanthemata, for which such hospitals chiefly exist, the disease is communicated usually, if not exclusively, by means of the epidermic scales. In a similar way it has been found that such bacilli as those of tuberculosis can only be carried into the atmosphere when they are buoyed up by fluffy material such as threads of a handkerchief, etc. It is accordingly exceedingly probable that any apparatus which is sufficiently fine to keep back fungi will be all that is required for hospital purposes . . ."

"It is not necessary for us to point out that the experiments which we have made cannot be applied directly to what would naturally occur if such screens were placed in the building in which their use is contemplated. In the first place, the rate of transmission of the air would undoubtedly vary with the resistance offered by the screens. In the second place, the passage of the air under these conditions is no doubt different from that in our experiments where the germs are both drawn in by a *vis a fronte* at the same time that the germs are projected on to the surface of the screen by a *vis a tergo*. How these altered conditions would precisely affect the results it is impossible to say, but we can conclude without much risk of falling into error that the screens, as experimented upon, permitted only of the passage of one-third to one-fourth of the germs, both fungi and bacteria, which were originally present in the air."

The report also points out that with finer screens than were employed, if of ample size to permit of the passage of air at a low velocity, still better results might be expected. I have therefore had a building erected in which these suggestions can be adopted, and tests will shortly be made exactly on the same lines as when the screens are employed for the purification of air emitted from infectious hospitals.

The report further draws attention to the fact that the passage of large volumes of warm air through the screens, would volatilise a considerable quantity of the disinfecting fluid with which the screens will be constantly charged, and that in all probability any germs which might not be entrapped by the screens would thereby be quickly deprived of vitality, and moreover that the mere reduction of the number of germs would be a considerable safeguard, because dilution of the germs lessens the severity of their effects.

As regards the cost of the method proposed, the necessary apparatus is quite inexpensive and easily applied, and I am prepared to show that buildings can be erected and equipped at considerably less cost than is now expended upon hospitals relying only upon the ordinary means for ventilation, without any appliance for purifying the air emitted.

Hitherto the cry has been for *space*, more *space* for the patients—which, beyond a given area known to be necessary for nursing purposes, in reality means *air* more *air*. This however cannot be secured in a building of moderate dimensions, without draughts, by what is termed "natural ventilation" or even by mechanical extraction: for no application of those methods has yet been made by which change of air, throughout an apartment, can with safety be effected more often than three to five times per hour, hence the demand for more and more air space within and proportionately expensive buildings, but by a system of propulsion, as proposed, there is no difficulty in increasing the change of air to ten, twelve or even more times per hour without creating unpleasant draughts.

With such a constant change of air, where, I would ask, is the necessity for more space within than is required for tending the patients?

I contend that with suitable appliances, by which the air can be constantly and quickly changed, buildings might be less in cubical capacity by at least one-third.

Not only would this reduction in size more than compensate for the cost of apparatus and its working, but the daily labour and charges for heating, lighting, cleaning, administration and maintenance would be proportionately less.

Another point of importance is, that those who tend the patients would be constantly in a pure atmosphere, for no sooner is the air vitiated by contact with the patients, than it is at once purified and expelled.

I realise that those who have not fully considered the possibilities of ventilation by propulsion will hold that I am advocating a retrograde movement in hospital construction, for I know, but too well, what an unreasoning prejudice there is to ventilation by mechanical means, particularly on the plenum principle, fostered as it is by the partial and misleading statements, so ostentatiously advertised by those who have cowls and the like to sell, that if I were not convinced by observation and experiment that it can be advantageously employed, I should certainly hesitate to urge its adoption.

Having enlarged upon the subject of isolation by ventilation in a paper on "Hospitals" read in the Spring of this year, before the Leeds and Yorkshire Architectural Society, I will content myself with directing your attention to this fact, viz., that the propelling power of wind is far more effective in securing ventilation than its power of suction, to prove this you have but to open a door or window, and almost invariably there will be an inflow.

A rotary fan is a simple contrivance for raising wind of any required force at will, whatever may be the state of the outer atmosphere. By using a fan to propel air into a building, the source of supply from which it is drawn is known, it can be cleansed, tempered and humidified, and a constant change of air can be secured at comparatively slight cost. All this has, in actual practice, been abundantly proved in the many buildings already ventilated by Mr. William Key, and I do not doubt that, as the methods he employs become more generally known, it will be realised as important to the health and comfort of communities that the air supply, not only to hospitals, but to churches, schools, assembly halls, theatres, and even to our dwellings, should be delivered pure and in ample volume, as the necessity is now recognised for an abundant supply of water free from pollution.

If instead of permitting the vital principles of disease to be carried off with the air emitted from infectious hospitals, means were adopted for entrapping and destroying them in a manner such as I have described, there is reason to believe that infectious diseases, now the cause of so much suffering and distress, might in time be banished from our coasts.

Dr. **FRANCIS VACHER** (Birkenhead) said that Mr. Henman had explained to them in a very interesting manner how the hospital might be effectually ventilated, and that, to many of them, was really a novelty. What had especially attracted his (the speaker's) attention was the screen which had been described. Many years ago (1875) he had been instructed to prepare a report for the Manchester and Salford Sanitary Association with reference to the effect of noxious vapours in chemical districts upon employés and the inhabitants living in the vicinity of works. He found that though occasionally those employed at the works were more or less prejudiced by the fumes they got to a certain extent inured to them, while the people who occupied cottages hard by were incommoded by the dust, carbon, and noxious vapours which came in through the open windows. He proposed as a remedy simple flannel screens hung up at the top of the windows, so that when the upper part was let down the air would come through the screens. These mechanical strainers were to be kept charged automatically by syphon bottles with certain chemical solutions to eliminate the offending gases or vapours. If the object sought be to engage the carbonic acid, a strong solution of soda or potash might be used. If it be desired to decompose sulphurous acid weak Condy's fluid might be used. So, also, free chlorine might be separated by dilute ammonia.

Sir **Thomas Crawford** (London) said he felt that the scheme propounded was one requiring very careful consideration and examination. He had had considerable experience in the matter of the ventilation of hospitals, and in the use of such screens as had been described for the purpose of modifying the conditions of atmospheric air introduced into buildings. In dry warm climates where the English Army served they were very often driven to expedients for reducing the temperature and dryness of the air, for which purpose screens similar to those described were used. Atmospheric air was driven by the force of the currents prevailing, through the screens into the houses. His experience of the process, in so far as it affected the air in the buildings, was not in favour of introducing any such system of screening the air drawn or driven into the hospitals in this country. In the first place it was extremely difficult to regulate the amount of moisture taken up, and he was not quite sure that it was proved that they did not add more deleterious matter to the atmosphere than they could possibly remove from it. Wounded people were most sensitive to impurities of air, and the universal experience had been that the safety of the wounded was in proportion to the command they had of the free atmosphere. As a matter of fact, in many cases, medical men have a great deal more success in treating wounded under a hedge-row than in a hospital. He thought the artificial ventilation of hospitals had been proved to be a failure. In England the direct admission of the purest atmosphere procurable, without any mechanical means, was in his opinion the safest form of ventilation.

Councillor **Compston** (Rawtenstall) suggested that the last speaker had lost sight of the main object of the paper, which was the purification of the air of infected hospitals. The air from small-pox patients, for instance, might be a means of spreading infection to the people outside, and the paper dealt with that question.

Mr. P. **Harding Roberts** (Holywell) asked what would be the necessary force of the current of air passing through the room (to insure the purity of the atmosphere) taking into account the friction caused by passing through the screen close to the bed of each patient.

Surgeon-Major **Black** (Edinburgh) referred to a hospital in Manchester where the air of a surgical ward was made antiseptic by the use of the Lister system in treating cases. The effect was so good that the patients in this ward recovered more satisfactorily than in the other adjacent wards, till the antiseptic air permeated into them also by the corridors, when it had the same beneficial effect. He thought it was a wrong principle to introduce the pure air at the top of the room, but it could be brought down by shafting to the floor levels, where it is wanted. A good deal of the foulness of the air in hospitals was created by the patients themselves, and the first object should be to purify the patients who were treated in the hospital, as is effected in surgical cases by the Lister air methods.

Dr. G. A. **Kenyon** (Chester) said the intentions of the reader were most excellent, and any work that could be done in the direction that he had suggested would be valuable, but his enthusiasm had carried him too far, and it would not do for The Sanitary Institute to appear to endorse his views in their entirety. What the reader had said with regard to the defects attaching to other systems of ventilation was worthy of very serious attention. It can only be by hearing the opinion of rival inventors of each others' inventions that the uninitiated have a chance of discovering weak points.

Mr. T. H. **Harrisson** (Liverpool) remarked that it was generally found that mechanical ventilation would not do unless it could be made to work automatically, otherwise it got neglected, and although the arrangement appeared to be perfect in theory yet negligence might make it useless. That it was nobody's work in particular would be the excuse for such negligence. He should like to ask how many of these screens there were in use in a hospital? He took it that there was one behind every bed, and that they would have to be attended to and cleansed at certain intervals. He wished to know whose duty it was to do this, and if the nurses had to attend to such a large number of screens? Was it not highly probable that such a system would fall into disuse, as had almost always hitherto happened?

Mr. W. **Henman** (Birmingham), in reply, said that as the method he proposed for purifying air emitted from infectious hospitals was entirely novel he could scarcely expect to convince everyone present that it was practical, although he was gratified to find that, from their independent observations, some realised the possibility of safeguarding the public thereby. It was unfortunate that Sir Thomas Crawford had entirely ignored the subject of the paper and simply condemned ventilation by mechanical means, basing his objections upon what was unsuccessfully attempted five-and-twenty years ago. Having heard similar statements of objections without argument hundreds of times repeated, he could only suppose that certain people, who at that distant period became acquainted with the adverse opinion then formed of mechanical ventilation as applied principally in foreign hospitals, can never get a step forward or realise by examination that with fuller knowledge and improved appliances the success of mechanical ventilation is now assured. He would ask, was it likely that shrewd business men of Birmingham forming the Committee of the New General Hospital, upon which over £200,000 is being expended, would determine upon a system of mechanical ventilation without examining minutely into the question and being convinced of its practicability and advantages? He had gone up and down the country examining hospitals, and the constant cry was for a reliable system of ventilation, which is certainly unobtainable in all weathers without mechanical means. That, however, was not the subject he had introduced to their notice, but the purification of air presumed to be charged with disease germs thrown off from patients suffering from infectious disorders. In answer to questions, he stated that experiments conducted by experienced bacteriologists conclusively proved that screens, such as he had described, did to a large extent eliminate the germs from air in its passage through them. That when the air is frequently changed, as proposed, the exhalations from patients do not contaminate the atmosphere of the ward, but are quickly forced out by the continual inflow of fresh air; and as to the amount of attention required for keeping the screens in working order, the arrangements, as he had explained, could be made practically automatic. No doubt the screens would have to be changed from time to time, but being simply placed over the mouths of the air outlet flues a few seconds would suffice for making the exchange, which probably would have to be effected not more often than once a week, and surely that would present no great difficulty.

On "The Nation's Wealth," by ROBERT WILLIAMS, A.R.I.B.A.

I.

THE greatest among the many blessings which were set upon the head of the Father of the Faithful was the multiplication of his progeny; they were to be as the stars of heaven, and as the sand upon the sea shore for multitude.

In these days of the rapid augmentation of the numbers of the people, and the never ceasing discussion and planning as to how to provide for and dispose of those whom some term the "masses" and others "the working classes," and in the face of the evident trouble caused to many, from the days of Malthus down to our own, as to the overfilling of our island, one would be inclined seriously to doubt the *bonâ fides* of the blessing promised to Abraham.

But fortunately there are in our midst unimpeachable witnesses who prove conclusively that as the people increase so does the nation's wealth. In fact, the people are the wealth.

These witnesses are the ground landlords of London, Liverpool, Manchester, and of all our large towns. The working population together with the poor and very poor, form two-thirds if not more of the population of all large towns. Take these away and the whole fabric of our national wealth falls to the ground.

Let us take a case. In a district of London inhabited by the very poorest of wage earners, where the death and birth-rates were abnormally high and disease always rampant, a number of little courts and alleys were, by order of the County Council, condemned and demolished. The site measured just half an acre. Its ground rent £90 a year. Immediately the site was cleared an offer of £350 a year, payable in advance, was made and accepted.

The buildings to be erected on the site were for the poor of the neighbourhood, who pay an average of 3s. 10d.* per room per week. The half acre would accommodate over a thousand persons at the rate of persons per room (from three to four) obtaining in the neighbourhood.

This, I think, and it is a common transaction, shows conclusively that the people are the nation's wealth. In one stroke a gain of £260 a year is made, and with little or no trouble. Besides this, the population placed on the site provides a handsome return to the speculator, high fees to lawyers, surveyors, and others.

Take a case in another class,—the rent of a ten-roomed suburban house, with good front and back gardens, may be set down at £54 a year, including all taxes. This gives an average rent per room per week of 2s. 1d. or 1s. 9d. per room less than the slum-dweller has to pay for an apartment lost in the mazes of a rookery or in the heart of an airless block, with no redeeming view of sky, flower, or tree. We may well stand amazed and ask—are these things indeed so?

II.—Crowding and Pestilence.

That the crowding of people together in large masses, as in block dwellings and narrow streets, is conducive to pestilence, is as true now as it ever was. The reports of Medical Officers of Health amply prove this.

---

* See Report of Royal Commission on Housing of the Working Classes, 1884.

We may, I think, justly regard any town to be in a pestilential state which has an average annual death-rate of 26 per 1,000 as at Liverpool, for this proves, if we may take the average of London as a guide, that in the more congested parts of Liverpool we may find the death-rate as high as 40* per 1,000.

In 1854 Dr. Southwood Smith published a pamphlet on the "Results of Sanitary Improvement," in which by way of comparison he gives the following table:—

1854.	Population.	Annual Death-rate per 1000.
Metropolitan Buildings	1,343	7
Whole of London	2,420,619	22
Potteries, Kensington	1,263	40

Now he describes the "Potteries" as "wholly destitute of the Sanitary provisions secured to the improved dwellings," with little or no drainage, no supply of water, no means for the removal of filth, and the houses he says were "dirty, damp, and miserable beyond description or belief."

Forty years have passed away, what further result can we show from the improvement of sanitation. Let us show this by a similar table:—

1891—4.	Population.	Annual Death-rate per 1000.
Metropolitan Buildings †	291	14
Whole of London	4,349,166	21·2 ‡
Liverpool	507,230	25·9 ‡
Katherine Street Buildings (London)	699	28·6
The Boro' Road District	16,624	32·3
St. Giles, South	13,450	35·6 §
4 Model Blocks in the East End	2,380	41·0

These two tables prove that our advance in sanitation has not kept pace with our increase of population and material wealth; but while we are bound to acknowledge this we must at the same time recognise, and very fully, that had sanitarians lain idle all this time our condition would be more terrible than our imaginations dare picture.

---

* The Vauxhall Ward of Liverpool had in 1893 a death-rate of 46·9 per 1,000! Number of deaths 283. Corrected average 43·2! [From Medical Officer's Report, 1893.]

† Another set of buildings erected in 1854, the year of Dr. Smith's pamphlet, and mentioned by him.

‡ Quarter ending March 31st, 1894.

§ Average for the ten years, 1882—1891.

That crowding is a source of pestilence may be proved from the fact that the death-rate increases as the population increases in density per acre.

III.—The General Evils of Crowding.

The denser the population the more liable to disease. But let me here quote the words of Dr. Waldo, the Medical Officer of Health for the Parish of St. George-the-Martyr, Southwark, he writes in his report for 1893 :—

"The more crowded a community the greater—speaking generally—is the amount of abject want, of filth, of crime, of drunkenness, and of other excesses, the more keen is the competition and the more feverish and exhausting the conditions of life." And to this true, though terrible, indictment of crowding he adds the following sorrowful note :—"The correction or amelioration of these indirect influences are outside the domain of the Public Health Department." This is a sad admission. The Public Health Department is like the voice of one crying in the wilderness, pointing out the terrible dangers, and at the same time declaring itself powerless to insist on our taking the right road, while the busy British public goes on its way regardless of all but present cost, compensation, and percentages.

May we not pause here and ask ourselves in this great commercial city of Liverpool, Whose business is it that these terrible influences, of which Dr. Waldo writes, should be at least rendered nugatory?

A High Birth-Rate.

There is an evil from crowding which reacts upon the community in the form of greatly augmented disease and death-rates, and that evil is an abnormally high birth-rate. In the slums and crowded block dwellings there are invariably high birth and death-rates.

Let us prove this by taking the highest death-rates in the table just given.

1891—94.	Population.	Deaths per 1000.	Births per 1000.
The whole of London............	4,349,166	21·2	31·4
Liverpool	507,230	25·9	37·0
Borough Road District	16,24	32·3	38·1
St. Giles, South	13,450	35·6	41·3

A HIGH BIRTH-RATE MEANS A LOW PHYSIQUE.

Over and over again it has been shown that the physical type degenerates in the denser part of towns, and this degeneration is brought about by a process resulting in a sub-division, as it were, of human life. As in plant life so in human life. Plants will not develop if too thickly set. Just as plants need room so do children. This is a common axiom and an elementary truth.

But as distinguished from plant or animal life, there is the stinting of the higher and moral growth. It was shown in evidence before the Royal Commission on Housing of the Working Classes (1884), that the standard of morality among the inhabitants of these crowded quarters was higher than might have been expected. But the Commissioners go on to say, "If there has been some attempt to throw doubt on overcrowding and the single room system being the immediate cause of immorality, no one has ventured to express an opinion that they are not most destructive to bodily health."

I would emphasise the words *most destructive to bodily health*, and, from my own experience in the slums, would add "and highly detrimental to spiritual health."

The evil effect of crowding on child life is well described in "The Life and Labour of the People," by Mr. Charles Booth. After giving a sickening, though perfectly true, description of the abodes of the one-roomed dwellers, he goes on to say that: "Fully a third live in single rooms, often so small and unwholesome that sickness is a constant tenant too. There, in a space that would hardly suffice for the graves of a household, father, mother, and children (sometimes a lodger too) work out the problems of domestic life."

* * * * *

"These are the children's homes. The parents, compelled by poverty or by inclination, are content to dwell in them. Their children, born and brought up under such conditions, take the colour of their surroundings and, following nature's law, grow up to repeat the parental type."*

Some idea of the child population of London may be gathered from the statement that in 1892 there were no fewer than 707,342 children of school age, showing an increase for the last eleven years of 11,000 a year.†

Judging from the large percentage of London people (a population as large as that of Liverpool) who live in one-roomed tenements, it is sad beyond measure to contemplate the future of thousands of their children born into the dirt and dreariness of a dull and sunless slum world. "The slum look is everywhere. It penetrates like a slimy fog into the school itself. 'Slum-born' seems written on the faces of the children, hardly one of whom impresses us as being up to the average. There are a few exceptions, wholesome-looking faces, but very few. We see numbers of half imbecile children throughout the school; big boys in low standards who cannot learn try as they may, children of drinking parents chiefly."*

---

* "The Life and Labour of the People."

† Pamphlet on the London School Board, Alexander & Shepheard.

To pass on! Statistics such as those of the Medical Officers of Health and of Hospitals, and especially those published by the Metropolitan Asylums Board, together with their most useful maps, show unmistakably that the crowding of people is productive, from that fact alone, of much sickness, fever, and pauperism.

But the loss to the nation through all this physical weakness, the loss of brain and muscle power, and the enormous cost of the maintenance of hospitals, workhouses, infirmaries, reformatories, asylums, and police is incalculable. But this direct loss, stupendous as it is, is not to be compared with the moral loss, the loss of brightness, of joy and happiness. Yet all this might be changed in any community who carried out the laws of health as known and understood in England.

IV.—Suggested Remedies.

There is an idea amongst English speaking people that there is over-population: various remedies are sought after. Malthus seemed to think that pestilence was a blessing in disguise, and which weeded the population of its weaklings just as a man might weed his turnip bed.

William Cobbett, who was chary of belief in the supposed increase in the population of his day, put his broad hand upon the evil of crowding, and roundly taking Malthus and the prohibitors of marriage to task laid the blame on the congestion of towns, some of which began to increase and greatly multiply in his time at the beginning of the century.

Cobbett plainly showed, though without the hygienic knowledge now prevailing, that a huge agglomeration of people in towns and the consequent depopulation of the villages was a terrible mistake.

This mistake is more emphatically a mistake now than it ever was. This very summer has shown how great is the evil. The beautiful Vale of Glamorgan was this year blessed with unusually good crops of grass and corn, but the weather was irregular—a few fine days and more of rain. But had there been a sufficiency of labourers, I can say from my own observations during a five weeks' sojourn in the Vale during harvest time, that a very large quantity of crops might have been saved or brought home in better condition. I saw field after field of beautiful corn "white unto the harvest" but no labourers. I saw grass absolutely spoiling for want of cutting. At the same time in the adjacent town of Cardiff where, owing to its great commercial success, the question of over-population and housing is forcing itself to the front, there were thousands of men and women on the verge of starvation, to whom a few weeks of harvesting would have been a blessing to health and pocket.

---

* "The Life and Labour of the People."

The large town truly is the result of so-called commercial success, but plainly it is a failure from a hygienic point of view, and from the instance just given, we may venture to say it also fails greviously in the truly economic sense. It robs the land of its meed of labour and gives rise to an abnormal increase of the population, which, by its physical and moral weakness reacts for untold evil upon the nation at large.

AS TO OVER-POPULATION.

The question of over-population is cropping up even in our broad colonies. A correspondent wrote to me a few weeks since, as follows:

"What is the quotation from the late Edwin Chadwick showing that excellency of sanitation is a remedy for over-population referred to by you in a late number of *Land and Labour?* It is very likely that such a law exists as a sort of natural regulation of supply and demand. If you could conclusively show this, you would be doing a very great service."

I think the statistics of the Registrar-General prove that given more room for the people to breathe, the death and birth-rates would be lowered. Take the following tables compiled from the summary for the year 1892.

Table of Six Densely Populated Towns, 1892.

Town.	Population.	Persons per Acre.	Birth-rate per 1000.	Death-rate per 1000.
London	4,263,294	57·1	30·9	20·6
Liverpool	513,790	98·6	34·7	24·7
Plymouth	85,610	58·3	29·1	18·3
Bolton	116,261	48·4	32·7	22·8
Manchester	510,998	40·0	33·7	23·8
Salford	210,058	38·9	35·9	24·6
Averages of the six towns...	....	56·88	32·83	22·55

Table of Six Towns not so Densely Populated, 1892.

Town.	Population.	Persons per Acre.	Birth-rate per 1000.	Death-rate per 1000.
Croydon	106,152	11·8	26·5	15·8
Huddersfield	96,599	8·2	23·0	18·1
Norwich	102,736	13·7	30·5	20·0
Halifax	84,097	22·3	25·9	19·5
Bradford	219,262	20·3	27·2	18·0
Oldham	134,221	28·4	29·1	22·0
Averages of the six towns...	....	17·45	27·03	18·90

The first table shows an average increase of births over deaths 10·28 per 1000 with a density of population of 56·88 to the acre.

The second table gives an increase of 8·13 per 1000 of births over deaths with the lesser density of 17·45 persons to the acre.

But the more dense populations have a birth-rate higher by 5·8 per thousand, and a death-rate higher by 3·65 per thousand. I am not going to say that my tables prove anything conclusively, because conditions of labour, of climate, and of general salubrity have to be taken into consideration, but we may certainly conclude that *space*, or breathing room, is the determining factor in good sanitation, and that the conclusions of the late Sir Edwin Chadwick are right, namely, "that the proportion of births is greatest where there is the greatest mortality," and that "in the highest sanitary conditions, it is observable that the proportion of births to deaths is rather reduced than otherwise." The latter remark is that to which my Quebec correspondent alluded, and it was made by the great sanitarian nearly fifty years after the first, showing that he had not had cause to change his opinions notwithstanding the great strides made in sanitary study and practice.

REMEDY, MORE SPACE.

The remedy, then, rests with new legislation, which will grant a health-giving space to each man. No quarter of a town should have more than 100 persons to an acre, and the general average should not exceed 30. Some such enactment should be made for guidance in the formation of new towns, such as the new seaport Barry, near Cardiff, some parts of which are so closely built that in a very few years they will become slums.

ASSOCIATED HOMES.

In large towns municipalities might arrange associated homes, designed in blocks of not more than four storeys—preferably three. There should be wide streets in front. No block should accommodate more than twelve families. Contiguous to the blocks should be a large open space, of not less than half an acre to each block. This space would form a common lawn, with trees and flowers; some of the trees might be fruit-bearing. There should be large meeting-halls, refectories, and libraries, together with arrangements for baths and general heating.

THE PARISH COUNCILS ACT.

If wisely and generously interpreted, this Act should greatly help sanitarians in their efforts to bring the nation to a good state of health.

Under existing circumstances and modes of farming we see by the undoubted proofs of statistics that fewer and fewer people are working and living upon the land.

At the last census nearly a million and a half of the persons enumerated in London were born elsewhere, and the greater portion of these came from the country towns and villages.

But, as we have already seen, the towns have alienated the labourer from the land, and the artificiality of town life, with its drink, tobacco, and low amusements, have so pandered to his lower nature and so enfeebled his health, that he has become too enervated or lazy, even when there is a chance, to care for the health-giving employment on the land. The town, with its squalor and reeking smells, its gas and sordid glitter, is superior in his mind to the fair country, with its ever-varying beauty of blade, flower, and corn, of browsing animals, of fruit-laden trees, and of merry birds.

But it is not altogether his fault, at present he cannot live in the country if he would; but here is a plan for keeping him there.

Take a man past the middle age working on a farm. He has a son who has reached manhood. There is no work for the son on the farm, he is a surplus population, as it were, he must go away to the "works," or to some distant town, perhaps, to swell the ranks of the unemployed.

Now, instead of telling that young man to go away, let us by the Parish Councils Act give an allotment to the old man who has, owing to his healthy life, a good deal of work left in him. Let the allotment be of two or three acres.* Build a cottage thereon and establish the old man and the rest of his family therein. Now let the young man take his father's place at the farm, by-and-bye he marries and occupies the paternal cottage. The village is thus increased by a cottage and a family. In time others will follow, and a strong healthy community will arise. Carpenters, tailors, tradesmen of all sorts, librarians, schoolmasters and parsons will be wanted in the place, who will gain their livelihood by working for the farmers, allotmentees, and each other.

The crowding into towns will thus be much lessened.

There will be no fear of the farmer's crops spoiling. The holders of the allotments, tradesmen, and others will turn out in a body, if need be, and the crops will be safely garnered. I say, and firmly believe, that it will be in some such a way as this England will be made truly healthy and really merry, thus will her hills and valleys be made to sing with joy.

Professor H. S. Hele-Shaw (Liverpool) said that the paper seemed hardly suitable for this Section, but that was not the fault of Mr. Williams himself. The reader evidently loved the country and his heart was there, but he did a great injustice to the towns. The country itself was not necessarily more healthy than the town, for towns of the present day were being improved by the advances of Sanitary science. The death-rate of London was remarkably low, and Liverpool, which once had a bad reputation, compared favourably with many parts of the country. Therefore, he felt that they should raise a word of dissent from the proposition that because they had density of population they must necessarily have a great death-rate. He thought that the charge brought against towns as to their squalor, low amusements, &c., was not quite fair, nor were the arguments which Mr. Williams had used. He must say that a vast change for the better had taken place in towns during recent years, and the charge as to the low type of human beings to be seen in towns was also hardly just. He (the speaker) was once manager of a Board School in a densely-populated part of Liverpool, and the brightness, usefulness, and intelligence of the children were certainly equal, if not superior, to that of those in the country.

Mr. O. V. Yates (Sandbach) said that one of the principal reasons why people in the country went to the town in search of work, was because they found life in the country too slow. As regarded there being a lack of labour in the country, the fact was the crops were rotting for the want of men, for all the labourers desired to go to the towns. With reference to these tenement buildings, labourers would not have them. They all wanted small gardens, and therefore the system of building tenements would never be a success as far as the ordinary agricultural labourer was concerned.

---

* In his "Cottage Economy" Cobbett gave instructions "How to raise food (for one cow) on 40 rods of ground."

Mr. **Smillie** (Tynemouth) pointed out that this paper would have been more appropriate under the proceedings relating to the housing of the working classes. He thought that Mr. Williams was the only one who had attempted to solve the problem. Mr. Boulnois had put forward interesting facts, but had refrained from saying how the problem ought to be solved. In his opinion, the working population must be spread over a greater area than it had been previously.

The **President** of the Section (Mr. G. F. Deacon) said he desired to point out that which had not been sufficiently taken into consideration. It was that they were apt to regard the death-rate of Liverpool and the density of the population as peculiar to that city. But the fact was that if they took the cities of Manchester, Glasgow, and, he believed, also many other places and drew a certain ideal line around the dense parts of those places—including only that which in the case of Liverpool constituted the city, instead of taking it outside the limits which, except in Liverpool, had been extended within the last ten or twenty years—it would be found that among the intra-lineal cities, thus for the first time equivalently compared, the excessive relative density of the Liverpool population would largely disappear, while it was obvious from the figures that the death-rate of Liverpool would be much the lowest.

Mr. **Williams** (London) said he thought that Professor Hele-Shaw forgot, in speaking of the density of population as not necessarily meaning a high death-rate, that it was impossible to do away with the exhalations of carbonic acid, and they must remember that people herded together in large towns made the already impure atmosphere more impure. In some recent analyses of the air in some of the denser parts of London, it was found that generally the air was vitiated to a greater extent than was shown by the analyses of Dr. Angus Smith thirty years ago.* With regard to the low type of people he spoke of, he knew that people in towns were very often supposed to be much sharper than those in the country, yet, as had been shown in the paper, the real dwellers in the denser parts of towns were of a low type, both physically and intellectually. The high death-rate of the densely populated city of Liverpool showed the evil of placing too many people on given areas.

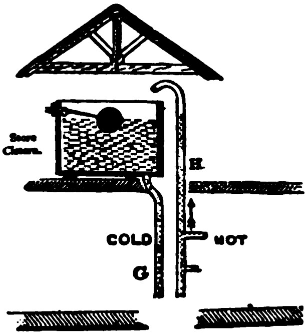
---

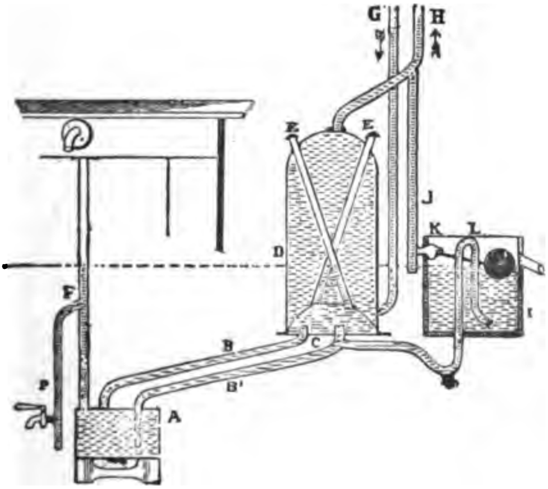
* These analyses are given in Dr. Angus Smith's "Air and Rain," and the comparison and more recent analyses in "More Light and Air for Londoners."

On "Domestic Boiler Explosions and Cylinder Collapses, their Cause and Cure," by James Walker.

ABSTRACT.

The author, after tracing the cause of boiler and cylinder explosions to the formation of steam under pressure, and the choking of the relief vents which were generally in exposed and inaccessible places, described an arrangement by which these evils might be avoided. The water from the boiler,





instead of circulating through the whole of the cylinder, is confined to an enclosed portion at the bottom, heating the other water in the cylinder by conduction only. This arrangement allows of the boiler and lower portion of the cylinder being freely ventilated at the low level, so that steam if produced would not be a source of danger. The other water in the cylinder and that circulating in the house pipes, being only heated by conduction could not produce steam. A syphon feed was arranged for the supply of water to the boiler to prevent water entering the boiler when empty. The short pipes which ventilate the cylinder and the boiler are steamless in operation and act as vent pipes only; the steam formed in the boiler and lower part of cylinder is condensed by the upper part of cylinder, and no inconvenience arises through these pipes being open in kitchens.

Professor H. S. **Hele-Shaw** (Liverpool) said he did not understand how the circulation of the water took place in the upper portion of the steamless non-explosive cylinder described by the author.

Mr. **Walker** explained the working of the machine by a diagram on the walls, after which Professor Shaw and the President of the Section offered some criticisms.

On "The Tub and Pail System," by Geo. J. C. Broom, M.Inst.C.E., F.G.S., Borough Engineer, St. Helens, Lanc.

There are at present about twenty-four towns in England which have adopted the Tub and Pail System to a considerable extent. Of these, fifteen contain a population of about 2,599,633 who are supplied with 136,444 water-closets, 92,239 privies, and 232,334 pails. They are situate principally in Lancashire, and are towns which have increased very rapidly both in area and population, which consist largely of a working-class population, and in which possibly it was considered that the water-closet system was not yet ripe for introduction.

In these towns the tub and pail system has found favour with the several corporations, principally, the author believes, by reason of the difficulties of the sewage question, giving rise to a desire on behalf of the Authorities to delay as long as possible the expenditure of a large amount of money in sewerage operations, until some definite scheme could be decided upon, also the necessity which the adoption of the water-carriage system would entail of providing a largely increased water supply. Under these circumstances the pail system has been recommended as the one which could be most quickly commenced and easily manipulated without waiting either for schemes of sewerage or of additional water supply to be propounded, or works to be carried out, and certainly as one which would give greater satisfaction and be more beneficial to the inhabitants from a health point of view, than the old privy system could possibly be.

Thus have many corporations adopted the system as the best for their purposes for the time being, irrespective of the question of cost, and not, until a very large number of pails have had to be dealt with, has this serious question of cost been brought with any great prominence under notice.

The system was first adopted in its entirety at Rochdale, where it has been carried out successfully so far as it is possible, since the time of its commencement in 1869.

It was finally decided by the Town Council of the Borough of Rochdale in 1868, on the motion of Mr. Alderman E. Taylor, that this system should be adopted, and in the following year (1869) it was tested by the Committee as against the "Goux" and "Morrel" systems, and considered by them to be much superior to either. At this time difficulties were experienced by the Council in the removal of excreta from the middens in the town, which had hitherto been removed by contract, and they then decided to themselves undertake the work of removal and to adopt the tub and pail system. At this period there were about 4,000 middens to a population of 38,164. The middens at once commenced to decrease in number upon the adoption of the tub and pail system, the population using the middens in 1873 being reduced to 25,970.

In the same year the Council made certain regulations requiring all the closets of new houses, additional closets to old property, and all privies rebuilt, to be constructed upon the new system, with the result that in 1892 only 900 persons were using the old midden system.

Difficulties were experienced in the disposal of the excreta to farmers in a crude state, and it was therefore necessary that something should be done to decrease its bulk, and at the same time to provide a manure which would be free from rubbish, more easily carried to and distributed upon the land, and which could be placed upon the market as a saleable commodity. This brought about the manufacture of the excreta into a dry manure, which at the present time has a ready sale at £6 per ton. The present number of pail closets in the borough of Rochdale is about 18,147, old privies and middens 138, and water-closets 650, for a population of 72,325. The author is not aware of any other town in the kingdom of its size having so large a proportion of pail closets.

The system itself is considered by some to be a dirty system, not only from the fact of its being impossible at times to prevent the emission of effluvia from the vans, but also from the fact that the pails are, in most towns, removed at all hours of the day, sometimes, in old properties, within view not only of the tenants but of the passengers in the streets, a cause, in the earlier hours of the day, to the author's knowledge of most bitter complaints from the inhabitants of many towns.

The difficulties attending the carrying on of the system are great, and it requires too much supervision for it to be worked really satisfactorily.

At St. Helens on the arrival of the van at the depôt, each pail is emptied immediately and is washed in a stream of running water, the inside and outside being thoroughly scrubbed. It is then dipped in a solution of carbolic acid, 1 to 40, and allowed to dry in the open air. A similar process is carried out in most towns.

It has been found that after a pail has been in use a year or more that a thin hard film of urate of zinc and other urates forms inside. When this comes in contact with carbolic acid compounds are formed which give off an unpleasant odour. To obviate this the pails are coated periodically with hot gas tar inside, and this has made a very marked improvement. When it is considered that in some towns there are at least ten or twelve thousand pails with interchangeable lids to be kept watertight, it is to be expected that there will be at least five to ten per cent. which will be defective, and for this reason alone it is practically impossible to make the system complete. Vans should be treated in the same way as the pails and should be as far as possible air-tight. Great care also has to be used in the removal of the pails, especially when full, to prevent splashing over, both in the back yards and in the vans, and this being dependent upon the men employed is consequently in precarious hands.

These matters are the backbone of the system, and if in any way neglected, naturally destroy its efficiency and create nuisances innumerable, bringing the whole system into disrepute, and weakening the confidence of the public. Further difficulties are often met with, such as slop water being placed in the pails, and often filling them to overflowing; and to educate the people to meet the requirements of the Corporation in this matter, necessitates the expenditure of no inconsiderable time and patience. It must also be considered that the system is a conservancy system, and is therefore far from perfect. To be a perfect system the pails should be removed each day, a matter not feasible, as the question of cost would then be six times as great as at present.

As to the cost of collecting the excreta and ashes under this system, the author is of opinion that the work can be done at about the same cost as under the old midden system. It is found very difficult to ascertain the exact cost of collection in many towns, as no separate account has been kept. In St. Helens the expenditure on the work has been very carefully recorded, and it is found to be equal to an average of 2·183 pence per pail per week for the ten years the system has been working; this cost includes the collecting of pails and ashes and carting same to depôt, and to this amount must be added the wages of men changing and washing pails, which is equal to ·185 pence, making a total of 2·368 pence per pail per week. An additional expense is however in many cases incurred as a result of some pails requiring to be emptied twice or perhaps three times per week, and as these pails are generally distributed over a large area this is a serious item, and increases considerably the average cost per pail.

The question of the adoption of some method by which the heavy cost of collection could be reduced has been long under consideration in St. Helens.

The experiment was first tried of collecting the ashes separately from the pails, the arguments in favour of this being that lighter vehicles could be used which could convey more refuse than the portion of the tub and pail vans appropriated for that purpose, would cover the ground more quickly, and that the pail vans would not be delayed during the emptying of the ashes and would therefore be able to collect more pails.

The result of this experiment however clearly showed that no saving whatever would be effected in this way, but that the cost would be increased.

The ultimate conclusion come to was that the most economical method of carrying out the system would be that of dividing the borough into districts, each district being in turn dealt with by the whole staff thus enabling the foreman to exercise greater supervision, less labour to be employed in emptying the pails, three men instead of four being able to work two vans. This method is now being carried out, and although only recently commenced has proved so far to be a saving in expense.

The excreta after its arrival at the depôt has to be dealt with, either by mixing the stuff in its crude state, with ashes and grinding, or by drying and manufacturing it into a manure as is done, as before stated, at Rochdale.

One other method of treating the excreta is that carried out in America on the banks of Hemlock Lake—the water from which is used for drinking purposes for the city of Rochester. The shores of the lake are used as a summer resort, and therefore it is at that period of the year that the greatest quantity of sewage is collected. The process is as follows:—

The pails and garbage are collected and removed to the foot of the lake in a flat bottom steamboat; it is then transported by a tramway 1800 feet long to the disposal ground where the refuse is treated as follows:—

Narrow trenches are excavated 3 feet apart and 3 feet deep, care being taken that the permanent level of the subsoil water is not reached; the contents of the pails are deposited therein in thin layers, and immediately covered with dry loam to a depth of 6 inches. After each trench is filled it is rounded up with earth, the location of the trench recorded, the surface being cultivated and cropped. During the year 1890, 3,128 cans and 80 tubs of garbage were so treated.

In November, 1890, the soil of these trenches, which were filled one, two, and three years before, was examined to ascertain whether complete decomposition had taken place. In trench No. 3, used in 1888, no quicklime was employed to hasten decomposition; nevertheless, the soil exhibited no trace of putrescible matter, either by appearance or odour. In trench No. 2 quicklime had been strewn upon each layer, and then covered with a layer of earth; traces of the lime and a discolouration of the soil could plainly be seen, but the earth was free from unpleasant odour. In trench No. 1 the use of lime was commenced in May, 1890, and only partial decomposition was found to have occurred after the lapse of six or seven months.

It was also found, as anticipated, that the destruction of organic matter took place much more quickly near the surface than at a depth of 3 feet. The soil is a clayey loam from 4 to 5 feet above the level of the lake. From these examinations it appears that shallow trenches are better than deep ones, and that after a period of three years the indication is that the same trench can be used again. The pails are washed and deodorized with a solution of copperas, and dried before again being used. They are made of galvanized iron, and coated inside and out with black asphalte varnish.

Probably, however, this system of treatment would only be of real use in exceptional circumstances, and the cost would prevent its general adoption.

In the event of the tub and pail system being adopted, the other portion of the sewage, such as washing water, etc., together with the sewage from existing water-closets, has still to be dealt with, and the cost of treatment of the sewage at the outfall will not be reduced in anything like the proportion of the expense incurred by reason of the adoption of the pail system. Works of sewerage, which will in every way meet the requirements of the Local Government Board, have still to be carried out, and the sewers have still to be made of the same size and to the same extent, as if the tub and pail system had not been adopted. The cost of the sewerage and outfall works must therefore be added to the cost of the tub and pail system, in order to ascertain the total outlay in respect of the sewerage system of a borough.

With regard to the reduction of the death-rate in towns which have adopted this system, there appears to be no doubt that a beneficial result has been obtained. Whether this can still further be reduced by adopting the water-closet system has yet to be proved, but it is admitted by most Medical Officers of Health, and also shown by statistics, that in the towns where the tub and pail system has been introduced, the death-rate has gone down since the system came into operation, and particularly is this the case as regards the mortality from typhoid fever, a zymotic disease, of course, specially affected by sanitary conditions.

In St. Helens the death-rate for Typhoid Fever from 1871 to 1884 (the year when the pail system came into operation) was ·64 per 1000 per annum, and from the latter date to 1890 this was reduced to ·46 per 1000 per annum. It was also found from very careful inquiries, conducted by the Medical Officer of Health, that double the number of deaths and three times as many cases of sickness from Typhoid Fever occurred in the houses provided with privy middens as occurred in houses where the pail system was in operation.

A special arrangement is adopted for the collection and dealing with typhoid pails. They are specially constructed and painted red, and are distributed over the town where typhoid prevails. These are emptied twice a week and are collected in a light spring cart which holds twelve pails, the pails being treated as above mentioned and the excreta burnt in a destructor.

In Rochdale the death-rate has been reduced from 26·4 in 1865 to 1869, to 20·09 in 1893, which year was greater by 1·91 than in 1892 by reason of an epidemic. The death-rates of Rochdale have been as follows, viz.:—

1865 to 1869	26·4 per 1,000.
1870 to 1871	25·12 "
1882 to 1886	19·20 "
1886 to 1891	19·37 "
1892	18·18 "
1893	20·09 "

In Huddersfield it has been reduced from 22·59 in 1875 to 17·43 in 1892.

In Bolton	from 24	in 1884	to 22·7	in 1892.
In Bury	from 26·08	in 1876	to 23·36	in 1884.
In Halifax	from 31·5	in 1871	to 17·3	in 1893.
In Leicester	from 24·4	in 1873	to 19·6	in 1893.
In Manchester	from 28·7	in 1874	to 20·9	in 1893.
In Wigan	from 37·0	in 1874	to 24·2	in 1893.

The author is not, however, in a position to say that the adoption of the tub and pail system has been the only cause of this reduction. There are doubtless other sanitary improvements in towns to account for a reduction in the death-rate, but general experience shows that some part at least of the reduction is due to such adoption.

On page 672 will be found a table showing the death-rates for the intervening years for the above and other towns.

It will be seen from the above that Halifax and Wigan show the greatest decrease in the death-rate, but while Wigan only commenced the system in 1874, Halifax commenced in 1871, only three years after Rochdale. This town, therefore, has had plenty of time to ascertain both the efficiency and cost of the system.

In Halifax the collection is done by contract, but the officials are quite satisfied with the general results of the system, though they are of opinion that "like every other system it wants properly working."

Most of the towns which have adopted this system are not pressing the erection of the tub and pail closets at the present time, but are turning their attention very seriously to the question of water carriage, either by the use of the trough or of the waste water or fresh water closet, and the opinion generally appears to have again turned in favour of water carriage, doubtless the cheapest possible manner of conducting the sewage to any given point; and this is more especially the case in those towns where a sewerage system has just been completed or is now being carried out. The tub and pail system is also considered by all to be a most expensive system, and one which does not give resultant benefits proportional to the excessive cost in carrying it out in a proper and efficient manner.

The author is of opinion that the tub and pail system has in addition to the reduction of the death-rate, undoubtedly resulted in benefit to the community as against the old midden system, but that the question of cost is so serious, that no large town is now likely to undertake the adoption of the system.

Taking it as a whole he considers it has not been the success that was expected, although it may be still effectively adopted as an intermediate system in towns which are rapidly increasing, and which are not yet in a position to carry out a complete water carriage system.

In conclusion the author is of opinion the advantages and disadvantages of the system are as follows, namely :—

ADVANTAGES.	DISADVANTAGES.
1. That it has been, and is likely to be, beneficial as an intermediate system between the midden and water carriage, enabling Corporations as it does to give more time to the questions of sewerage, and to make experiments as to the best mode of dealing with the excreta under the varied circumstances of each town.	1. That the great questions of cost, both in the carriage of the pails and dealing with the excreta, is such that in large towns the system cannot be carried on with advantage.
2. That it is an immense stride in advance of the midden system. The excreta are removed more easily, more frequently, and with less nuisance, and there is no risk of them percolating into the surrounding ground, and polluting both soil and air.	2. That there are great difficulties in the way of its being carried out in a proper manner and without creating a nuisance.
3. That it may be of use in towns where an adequate water supply cannot be obtained readily or without excessive expenditure.	3. That being a conservancy system it is not the best mode of dealing with the excreta independent of the question of cost.
4. That it is well adopted to the wants of sparsely populated districts, and especially villages, whose water supply is taken from wells, and where the excreta would be utilized on the spot as a manure.	4. That in the event of its introduction, nothing is ultimately saved in the construction of a system of sewerage and very little annual cost in the carrying on of outfall works.

And generally, that the system is now dying out and will again give place to a water carriage system, which is certainly the cheapest and best mode of carriage at present possible.

Death-rates in various Towns since the commencement of the Tub and Pail System.

Year.	Bolton.	Bury.	Halifax.	Huddersfield.	Leicester.	Manchester.	Oldham.	Rochdale.	Salford.	Wigan.	Birmingham.
1871	......	......	31·5	......	......	......	......	25·9	......	......	......
1872	......	......	26·8	......	......	......	......	21·2	25·3	......	......
1873	......	......	23·2	......	24·4	......	......	21·1	28·3	......	24·8
1874	......	......	23·9	......	24·1	28·7	......	24·1	28·2	37·0	......
1875	......	......	27·7	23·6	27·7	28·4	......	23·9	29·5	32·2	......
1876	......	26·1	23·5	23·2	22·5	28·0	......	23·9	29·5	28·5	......
1877	......	27·3	25·8	22·4	21·4	26·1	......	......	26·3	28·8	......
1878	......	32·3	22·3	22·0	20·7	26·8	......	......	27·1	......	......
1879	......	23·7	25·4	22·9	21·1	25·2	......	......	26·7	......	......
1880	......	23·0	22·5	22·0	25·0	25·0	......	......	27·9	......	......
1881	......	21·2	21·4	20·4	21·8	22·8	22·7	......	22·5	......	......
1882	......	22·6	20·3	22·4	20·0	24·0	24·9	......	23·7	......	......
1883	......	21·3	19·6	21·4	19·2	24·4	22·5	......	23·6	......	......
1884	24·0	23·4	23·4	19·5	22·1	23·4	25·9	......	24·4	......	......
1885	20·7	......	19·5	20·1	19·4	23·6	23·2	16·7	23·0	......	......
1886	23·1	......	22·2	19·5	19·6	24·1	24·2	19·1	24·8	......	20·1
1887	21·2	......	21·0	22·2	19·0	25·4	25·8	18·2	25·5	......	20·0
1888	21·6	......	19·6	18·5	17·9	23·3	22·3	18·0	24·8	......	18·2
1889	22·0	......	20·6	18·8	16·7	24·2	22·7	17·5	25·1	......	19·2
1890	25·8	......	22·3	18·8	17·8	26·2	24·4	19·4	27·7	26·5	21·4
1891	21·8	......	22·6	23·0	21·21	26·0	25·6	21·4	26·0	24·7	21·1
1892	22·7	......	19 5	18·1	18·04	23·2	21·9	18·2	24·6	24·4	20·0
1893	......	......	17·3	17·4	19·6	24·3	20·9	20·1	24·0	24·2	21·5

Mr. Alderman BOULTON (Burslem) said he did not see that the paper needed any discussion, as the author had very fairly answered the question for himself, namely, that the pail system was fast dying out, and that it was only an intermediate system between the midden and the water-closet system.

Dr. AINLEY (Halifax) stated that in Halifax the tub and pail system, instead of dying out, was increasing every year, and an experience of twenty years made the people like it very much. They had weekly removals, taking it down to the depôt by the side of the wharf, and shipping it to farm districts where it was got rid of quickly. They adopted a regular block system of removal: they did it by contract, and they had two inspectors who looked after the contractor. The whole thing was done systematically and satisfactorily at a cost of about £6000 a year. He was of opinion that when they were called upon to stop the pollution of their rivers, it would be foolish to advocate a water-carriage system.

Mr. **Sadler** (Liverpool) considered that this mode of dealing with excreta might be much more adopted in districts sparsely populated where there was no system of sewerage, especially if a man could be had at intervals to empty the receptacles, as, by using a urine separator, weekly or even fortnightly might be sufficiently frequent. He lived in a suburb of Liverpool dependent on cesspools, and by adopting the above and a paraffin cask for coal ashes with revolving riddle on top, he got rid not only of the ordinary midden, but also of the ash-pit nuisance, vegetable and other refuse being taken direct to the manure heap in the garden.

Mr. Alderman **Noton** (Oldham) said they were spending £200,000 in the putting down of works for the sewerage of the town, and it appeared to him to be more cleanly and very much better to have it carried out by the water carriage system. Those who had to do with towns should consider the rates, and if they were obliged to construct works for the purification of the sewage of the town, why not use it in the same way for carrying the sewage down to the works, where it could be treated in the cheapest possible manner.

Mr. **Smillie** (Tynemouth) said that the pail privy system had been in use in the town he came from, and with admirable results to the health of the inhabitants.

Mr. S. S. **Platt** (Rochdale) said the pail system commenced there, and had been in operation for nearly twenty-five years, and there was no disposition to give it up. The town was worked entirely in districts, and the result was that complete supervision could be had over the men. He said this and many of the improvements at St. Helens had been an essential part of the system at Rochdale from the commencement. He referred to the different stages in the difficulties of the disposal in the past; to the marked reduction in the death-rate since the inception of the system, and to the advantages the system possessed in removing and dealing with the fæces from cases of zymotic disease.

The **President** of the Section (Mr. G. F. Deacon) observed that statistics of mortality put forward in the manner in which they were in this paper might be misleading. There were phases of mortality just as the moon had phases, and they all knew that since 1870 there had been a very general reduction of the death-rate in this country; unless, therefore, the figures in those tables were compared with the corresponding death-rates of other places, and the ratio fully given, it was almost impossible to draw conclusions from them.

Mr. J. C. **Broom** (St. Helens), in reply, said the fact of a gentleman using the system in his own private house was much in its favour, as it would have that necessary attention it required, but it was unsatisfactory if the men did not do the work properly. With regard to the question of certain pails being emptied two or three times a week, it was in some cases impossible to carry out the rule of one closet to each house, particularly is this the case in old property, there being very often no yard space to allow the closet to be erected. In some cases cottages had been taken down on purpose to make room for closets to be provided for the rest of the property.

On "*The Purification of Sewage Water for its use for Steam and Condensing Purposes,*" by ALDERMAN NOTON.

THE subject of my paper may possibly bring a smile of incredulity on some faces, for while it may be granted that sewage water may be used, the insufferable nuisance attending it would effectually bar the way to its extended use, and yet there are good qualities in it that deserve attention.

In the first place, it is alkaline in its nature and, from the development of sulphuretted hydrogen which attends it, mineral matters are precipitated and the consequence is, that from the use of such water there is little or no deposit of hard shale in boilers, which is an advantage over water with any degree of hardness such as most pure drinking waters possess, inasmuch as they carry in solution lime or other minerals which in course of time incrust the boilers.

I was led to the consideration of this question from the fact that the Palm Mill, of which Company I am Chairman, occupied a site on the lowest confines of the town. There was a small reservoir on the property which was fed by a stream which had practically become a sewer for the town, the supply of water was apparently so abundant that we thought we could use it for condensing purposes and let it pass, but a dry summer proved we could not depend upon it without impounding and using it over again, then the stench became a nuisance and we were obliged either to make a larger reservoir, costing from £2,000 to £3,000, or to find a means of making the water innoxious. In order to do this we built a large cooler which has since been extended. We did this because I thought it would serve a double purpose of oxydising the water as well as cooling it, and destroying the nuisance while preserving valuable water. The cooler was built for 2,000 horse power and is 90 feet long, 24 feet wide, and 20 feet high; the water is raised from a hot well by two centrifugal pumps to the top of the cooler and conveyed in the middle to its whole length by a large trough. This trough has 140 holes in it distributing the water into 140 narrow troughs that are laid the width of the cooler. These are laid perfectly level, the overflow descending in the form of rain on to a lattice bed 2 feet below and from that to other lattice beds 2 feet apart, the whole descending into a small reservoir in the mill yard and being reconveyed to the larger reservoir, in a cool state. The reservoir, which was originally intended for 150 horse power, is simply used for storing the water. The cooler takes about 42 degrees of heat out of the water, varying somewhat in cold and windy weather.

From observations we have taken we find that the cooler requires twice as much water as a reservoir, a considerable quantity being evaporated in steam, but as we have an abundant supply the loss is made good by introducing a fresh supply.

There are several results in thus using sewage-water that I wish to point out.

First, that by the water falling in the form of rain through the air the water is changed in character, and the reservoir from containing a mass of foul, offensive matter, is made innocuous and comparatively pure.

The *rationale* of the action of the air on the descending drops of water is rather complicated, but the effect with which we are most concerned is the destruction or conversion of the noisome sewage gas, or, to give it its chemical name, sulphuretted hydrogen.

By descending in innumerable drops the oxgygen of the atmosphere attacks the gas with the following results:—The oxygen combines with the sulphur and forms sulphurous or sulphuric acid, it also combines with the freed hydrogen and forms water. The alkaline matter in the water neutralises the acid, with the result that in the last operation the offensive odour is completely destroyed. That this is the true solution of the operation is proved by the fact that in London the sewage is treated chemically with sulphuric acid and permanganate of potash, which virtually performs the same operation.

The next point is, that it destroys all organic life while working. I have kept the water so treated in a stoppered phial for months without showing any signs of life or putrefaction, while the same water before passing through the cooler or condenser was offensive in a few days. But there is another point to which I wish to draw your attention, and that is, that the water is pure as long as the mill is working, but if allowed to stand for about a week it begins to get foul again, though not if it was in a stoppered bottle, and yet the whole of that water has passed through the condenser and cooler twice during the day. It may be that it is owing to the escape of air that has only been mechanically mixed, as we found, that working direct from the cooler we lost one half-pound of vacuum, but taking it from the reservoir when it was in a state of comparative rest the vacuum was better.

There is, however, another use to which the cooler may be applied, and that is by erecting it in the mill reservoir in such a manner that it can be isolated from the rest of it when the reservoir has to be sludged, to give time for the deposit to dry and be cleared out without stopping the works, this we have done, keeping the reservoir empty for three weeks for a thorough cleansing. It is well known that the practice of sludging, and sending part of the foul material down the drains of manufacturing towns, is of common occurrence. Seeing that every town is now obliged to purify its effluent it is unfair, as well as unlawful, to add to the difficulties of unavoidable pollution with which sewage works have to contend, by introducing a material of so foul a character as sludge.

It may be of interest to know how much it costs to put up an apparatus of this sort. If erected in a mill reservoir, and prepared for suitable isolation when required, it should not cost more than £600 for cooler, pumps, and pipes. At the present time we are indicated close upon 2000 horse power. The water required for condensing purposes is 93,300 gallons per hour. This amount has to be raised 20 feet high, and it is a matter of easy calculation to find out that it will take twenty horse power to do it. This at 2¼ pounds of coal per horse power, with coal at 8s. per ton, will be 9s. per week, making a further allowance of 1s. for depreciation, may be 10s. or £26 per year.

If we value the small reservoir at present existing at £700, we have a plant costing £1300 instead of reservoirs costing from £2000 to £3000, the larger sum would be probably nearer the mark; but it is only fair to say that the expenditure of £26 per year for power at 4 per cent. would represent a capitalized sum of £650, which added to the £1300 makes it equal to an expenditure of £2000, so that the difference is not very great except the fact that such capital is not a necessary expenditure.

We have the advantage of using water that costs nothing, and when treated in this manner, of superior quality for raising steam, and no boiler incrustation of any moment.

There is, however, one matter in the working of this system that has been clearly brought out, the sewage we use is comparatively clean, as the heavy matters are deposited in the sewer when it is stopped for the purpose of filling the reservoir, as it is an open sewer 15 feet deep and fills slowly before overflowing, when the shutter is opened the heavy material is swept away.

The reservoir had in it only an average of five inches deposit after six months work, and yet simple aëration does not permanently purify sewage-water, and it is absolutely necessary it should pass through filters or land to make the purification permanent, otherwise secondary putrefaction will occur.

In conclusion, it is necessary to observe that the sewage-water used is, principally, slop-water, as the town is worked on the pail system and we have no chemical or dye-works, and while sewage-water is taken advantage of by the mills in the town, it is generally during times of rain when it is considerably diluted, and it is taken with the addition of the gathering from the ground and buildings belonging to the premises; in our case, however, we principally depend upon it in dry seasons, and yet we use it without detriment to the locality and without causing a nuisance.

Major **Lamorock Flower** (Lee Conservancy Board) said he knew from practical experience sewage water had been used in works with very great advantage. He did not see why they should throw away such fluid, or why it should not be taken down to the works, and there purified in order to be used again. Then such water might be utilised advantageously in raising steam.

Alderman **Boulton** (Burslem) said he knew two towns where they used sewage water, and there was no incrustation in the boilers.

Mr. **S. R. Lowcock** (Birmingham) said he cou'd from his own experience entirely endorse the statement of the author, and the remarks of several speakers, as to the suitability of organically polluted water for steam boiler feed. He was very pleased to see the satisfactory results that Alderman Noton had obtained by the process described, as he had recommended a very similar arrangement to a large firm some three or four years ago. He considered that the fact that the water was inoffensive while the mill was working, and offensive when stagnant, was due to the activity of the purifying organisms contained in the water being promoted by the aëration and warmth when the mill was working. When it was stopped the water became offensive from this activity being suspended, owing to the absence of fresh oxygen, that in the liquid being used up by the micro-organisms in their life processes, and not escaping by evaporation as suggested by the author.

On "*The Purification of Sewage and Foul Waters by Means of the Magnetite Filter*," *by* W. DARLEY, F.S.I.; Surveyor and Sanitary Inspector, Basford Rural Sanitary Authority, Nottingham.

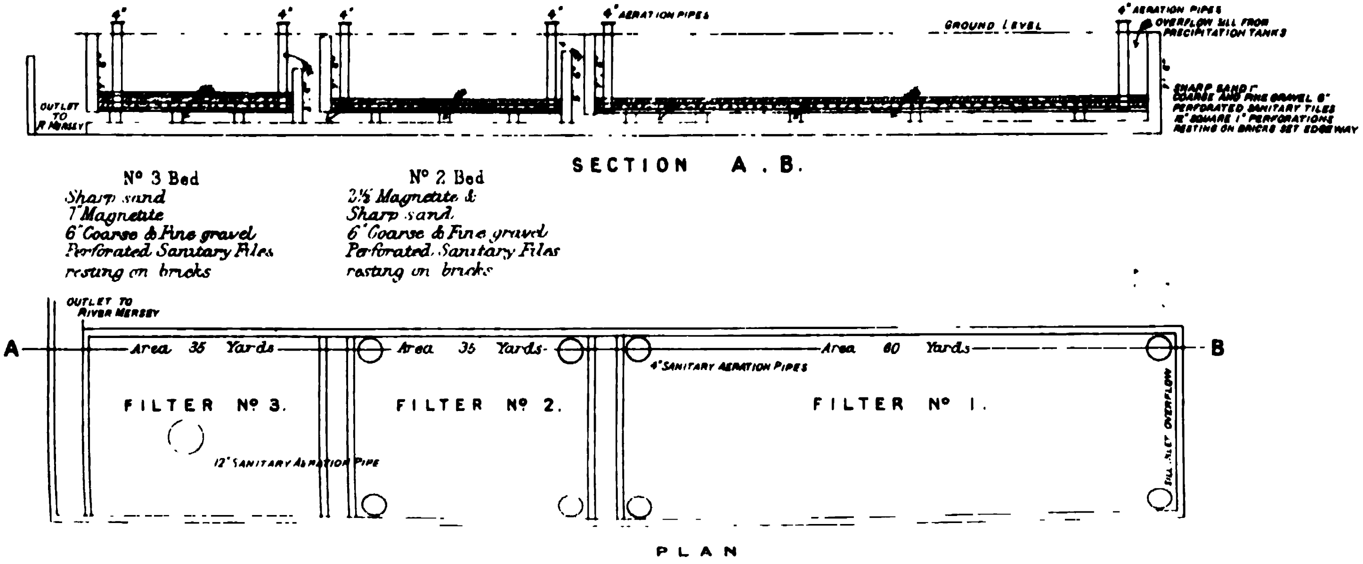
THE title of this paper will indicate to you that I am about to trespass on your good nature by reading a paper on a subject that has been already nearly worn threadbare, but the only apology I can make is that my paper is not a long one and is not based on theory, but on the contrary I shall speak in every detail from personal experience and experiment of an entirely novel process.

Some months ago I had brought to my notice the mode of purification of the sewage of the Heaton Norris Local Board at their works at Heaton Mersey. The population of the district is 6,000, and principally on the water-closet system. There are no manufacturers' waste waters run into the sewers, and so the sewage may be described as a normal one, the flow being estimated at 240,000 gallons per day of twenty-four hours, giving the high average of forty gallons per head of population; this, however, is accounted for by the fact that the district is largely residential, and baths are very numerous.

The system in vogue for the treatment of the sewage may be described as a constant flow system, the precipitant in use being alum cake, which is added in the well prior to the sewage passing by gravitation into the precipitation tanks, the alum cake being suspended in the well and allowed to dissolve by the passing flow. The tank is forty-two yards in length and ten yards wide, and varies in depth, from 8 feet at the inlet to 7 feet at the overflow sill, the capacity is 180,000 gallons. The sewage after precipitation flows over a sill forming a cascade of about one foot deep, which promotes to some extent aëration of the oxidisable impurities in the precipitated sewage effluent, which, however, I have taken samples of, and find that mere precipitation will not retard after-decomposition of the effluent, as my samples not only smell most offensive, but show a perceptible fungoid sewage growth. And now to deal with the filtration of this precipitated sewage effluent. The filter beds are 26 yards long by 5 yards, and are divided as follows:—The first bed 12 yards, the second 7 yards, the third 7 yards—the sewage flowing from No. 1 to No. 2, and thence through No. 3, to the outlet to the River Mersey (as shown on the plan, which is inserted opposite page 680.

Tank No. 1 (area 60 yards) is composed as follows: from the

"MAGNETITE" HEATON MERSEY FILTER BEDS



top, 1 inch sharp sand, 6 inches coarse and fine gravel, resting on perforated sanitary tiles (square with five perforations of 1 inch), and at each corner of the filter bed is placed a 4-in. sanitary pipe (two lengths), which is carried from ground level down through the sanitary tile, in order to admit of a current of air passing through the filter when at rest, for the purpose of aërating as much as possible the sand and gravel.

This filter merely acts as a mechanical strainer on matter in suspension contained in the precipitated sewage; the accumulation of this matter in suspension is very great, and at frequent intervals it is necessary to remove by skimming the deposit on the top surface of the sand. In no sense of the word can this filter be said to exercise any oxidising action on the sewage.

The effluent now enters tank No. 2 (area 35 yards); the construction of this filter is identically similar to No. 1, except that the layer above the gravel consists of 2½ inches of magnetite (the oxidising medium), mixed with a little coarse river sand (the sand being present merely to retain any suspended matter which might pass No. 1 filter); the effluent after passing through this filter shows a very distinct improvement in colour. Previous to passing No. 1 the colour of the effluent is a very palpable blue, containing a quantity of matter both flocculent and insoluble in suspension. After passing No. 1 the suspended matter is absent, but the colour does not vary, and it is not until the effluent leaves No. 2 that there is any very apparent change in colour.

No. 3 filter (area 35 yards). This filter is composed as follows:—A top layer of 1 inch of sharp river sand, below this 7 inches of magnetite with some pebbles in order to keep it open, and lastly the gravel and sanitary tiles as before. The effluent from this last tank is in appearance of a bright clear colour, with the characteristic sparkle of spring water. There is present no matter in suspension, nor is there any smell whatever. In fact this sewage effluent is better in appearance than many Derbyshire trout streams, and that this is so is borne out by the analysis of Messrs. Norman Tate & Co. of this city, which I will now read to you. I may now add that it was made after the filter had been working continuously from October, 1893, or six months about.

Institute of Chemical Technology and Analytical Laboratory,
9 Hackins Hey, Liverpool.
March 9th, 1894.

CERTIFICATE OF ANALYSIS.

We have examined three samples of liquid received from the

Heaton Mersey Sewage Works, per the Magnetite Company, Manchester, and have obtained results as follows:—

In 100,000 parts of liquid—

Samples Marked.	Raw Sewage. Feb. 22, 1894.	Unfiltered Sewage Precipitated.	Filtered through Magnetite.
Total solids dried at 212°	144·0	104·0	28·6
Suspended matter	11·8	5·6	Nil.
Suspended matter, mineral	3·0	1·6	Nil.
Suspended matter, organic	8·8	4·0	Nil.
Total solids in solution	132·2	98·4	28·6
Minerals	94·2	72·4	22·0
Organic	38·0	26·0	6·6
Chlorine	30·175	20·945	3·905
Oxygen absorbed in fifteen minutes at 80°	6·195	4·455	0·191
Oxygen absorbed in three hours at 80°	12·003	9·136	0·302
Free ammonia	5·000	5·300	1·000
Albuminoid ammonia	4·000	2·000	0·050

We have also had submitted to us a large sample of the filtering medium, "Magnetite," which we have analysed and experimented with, using the magnetite in conjunction with layers of pebbles and sand as a filter. The composition of magnetite is such as would add no impurities to waters filtered through it.

As a filter arranged in layers with pebbles and sand, we find the Magnetite very efficient as a purifying agent for sewage waters containing organic matters of an objectionable character in suspension, or solution, and is such as would prove of good service in the treatment of sewage or other polluted waters, for the production of an effluent containing no suspended matter, and in a safe condition to be run into rivers without causing pollution.

A. Norman Tate & Co.,
Analytical and Consulting Chemists.

These sewage works are situated on the River Mersey about two miles below Stockport, and within the jurisdiction of the Joint Rivers Committee of the Mersey and Irwell (and situated opposite to the Stockport sewage works, of which Mr. Deacon is the Engineer). This Committee is the prosecuting body in the Mersey and Irwell watersheds, and it speaks volumes in favour of this process of filtration that these sewage works have neither been warned nor prosecuted for river pollution since these filters have been at work (since October 1893).

And now a few words with regard to the permanency of the effluent produced by the magnetite filter. I have samples here to-day taken last October. They are as pure and smell as sweet as, in fact sweeter than, many drinking waters. They have undergone no secondary decomposition whatever; on the contrary samples of the sewage before filtration taken at the same time smell vilely and have set up fungoid growths.

I have gone very carefully into the composition of magnetite and I find that its proper designation should be a ferrosoferric oxide or a magnetic oxide of iron represented by the symbols $6\ Fe_3O_4$, that is FeO (Ferrous Oxide) plus Fe_2O_3 (Ferric Oxide) combined in the proportions of $6\ Fe_3O_4$.

One cubic yard of magnetite spread out will cover an area of eight yards, seven inches in depth, and this is the depth which has been considered necessary for normal sewage filtration, and when I tell you that this material is quoted at about one half of the cost of any other filtering medium, you will be able to realise that it is not a costly filtering medium, considering that 1,000 to 1,500 gallons of sewage can be passed through a yard per twenty-four hours.

And now as to its chemical action on contaminated sewage waters, I have drawn the following deduction from a series of careful experiments.

THE ACTION OF MAGNETITE ON IMPURITIES.

The sewage effluent, after filtration through magnetite, deposits ferric oxide in considerable amount; this hydrated ferric oxide is undoubtedly derived from the magnetite, and is present in the effluent after filtration, as ferrous carbonate ($Fe\ CO_3$), and this salt by absorption of oxygen, in the presence of water, becomes first ferrous hydrate, and lastly ferric hydrate, this represents the chemical action of magnetite upon carbonaceous organic matter in solution in sewage effluents.

Magnetite is in appearance very similar to new red sandstone, but instead of being crystalline is extremely amorphous (porous), in fact, is capable of absorbing 37 per cent. of water; to this extreme porosity is due its power of practically regenerating its oxidising power. That "Magnetite" is a magnetic oxide is demonstrated by the property a magnet possesses of attracting it, similar to the attraction of iron filings.

As to its oxidising properties, I have made the following experiments:—

1. Red gum guaiacum passed through magnetite became blue, showing the presence of an ozonising body.
2. Atmospheric air passed over magnetite turned a red gum

guaiacum paper blue, showing that the oxygen of the atmosphere had been occluded as ozone.

3. Potable water passed through a magnetite filter on the addition of a few drops of guaiacum, became of a distinct bluish tint.

These experiments, simple in themselves, lead me conclusively to believe that we have in magnetite a cheap body possessing remarkable oxidising properties, which must in addition prove of great service for potable water filtration purposes for removing organic and inorganic impurities.

For domestic purposes the efficiency of magnetite may be estimated from the following tests, which I have applied to a domestic filter containing two pounds of magnetite:—

One gallon of water, containing sixty-two grains of sugar of lead (acetate of lead) was passed through; no trace of lead after filtration.

One gallon of water, containing seventy grains of sulphate of copper (blue vitriol) was passed through the same filter, and no trace of copper could be found in the filtered water. Strong solutions of Condy's fluid (permanganate of potash) and litmus were completely decolorised by the same filter.

The same filter I then thoroughly washed in water, and on testing this no trace of the respective poisons passed through could be found, showing that a distinct chemical change had been brought about by the magnetite, and further of greater importance, the magnetite retained the various impurities passing through it, in an insoluble form, hence the impossibility of the contamination of drinking water, caused by overworked charcoal (in fact all filters in which carbon exists), giving up the various impurities which it has removed. Why this should be so is unknown, but, nevertheless, is admittedly a physical fact, common to all charcoal filters.

Magnetite and Lead Poisoning.

What is meant by lead poisoning? Simply this: The water supply of a certain district is derived from a source (generally peaty soil) which contaminates the water with an acid having the property of dissolving lead pipes, and this contaminated water, after standing in the lead service pipe for a few hours, contains sufficient lead to constitute a poisonous dose.

I have filtered contaminated acid peaty water through magnetite; its property of dissolving lead was entirely removed. No filtration through sand or gravel will remove the deleterious property, as is erroneously imagined by many; or in the alternative, the water containing lead, drawn from the tap, I have thoroughly purified by passing through magnetite in a domestic filter.

The advantages claimed for magnetite for filtration of polluted water and sewage over other filtering media are as follows:—

1. Permanence; it requires no renewal.
2. The property it possesses of rarifying itself.
3. Magnetite contains no carbon liable to become choked by impurities.
4. Efficiency in removing the first form of impurities, whether vegetable or mineral.
5. The worst sewage or waste waters after precipitation, and passing through magnetite, fulfil the requirements of the Rivers Pollution Prevention Act, 1876.
6. Magnetite can be laid down and used in conjunction with any precipitant which removes matter in suspension, and does not add deleterious matter in solution to the effluent to be filtered.

THE MODE OF APPLICATION OF MAGNETITE TO SEWAGE FILTRATION.

Many filter beds in use in this country are constructed on the principle that rapidity of filtration is fatal to thorough purification, and in many cases filter beds are constructed to filter 800 gallons per yard of filtering area per twenty-four hours; this means that an enormous area of filters is necessary, and in order to retard rapidity the filter is constructed somewhat as follows:—

Varying from 18 to 9 inches of fine sharp sand; 18 inches of filtering medium and coarse sand; 6 inches of coarse sand; 4 inches of fine rubble; 4 inches of coarse rubble; resting on perforated sanitary tiles, and the outlet of these filters is governed by a valve for the purpose of checking the free flow of the effluent.

Flocculent and suspended matter will, in course of time, find their way through these layers of media (however perfect the arrangement may be for upward washing of the filter), as after the suspended matter has passed down a few inches from the surface, upward flushing will not remove it, and this solid matter will eventually come to rest in the layer of sand immediately above the rubble and completely choke up the filter. No amount of flushing will remove this, and short of taking out the sand and washing, there is no possible means of cleansing, and an additional cause of the clogging of filters as described above is the weight, when wet, of the sand, compressing the lower sand and media to such an extent that it becomes almost impervious to the percolation of water.

The Magnetite Filtering System reverses the present order of things, combining rapidity of filtration and a decreased filtration area, with a production of a pure and innocuous effluent, at half the cost of any filtration scheme now in vogue.

The filter is constructed with only 2½ to 3 inches of top sand to retain suspended matter; this slight depth of sand admits of frequent upward flushing, and the weight of the sand is not sufficient to cause any impact of the strata below it. The magnetite is of the size of peas and beans, and is mixed with small pebbles of a similar size, 1 foot of magnetite to 6 inches of pebbles; below this, 4 inches of similar sized pebbles, resting on 4 inches of coarse gravel; and lastly perforated tiles.

A filter constructed as above will filter 2,000 gallons per superficial yard, per 24 hours, and the effluent after filtration I have found to answer the requirements of the Rivers Prevention Pollution Act, provided the greater portion of the solid matter in the sewage or waste water to be filtered, has before filtration been removed by subsidence or precipitation.

I have used different precipitants in conjunction with magnetite; different sewages require different precipitants, but the effluent from all can be filtered through magnetite with the production of a satisfactory effluent.

The question naturally arises, why, with such rapidity of filtration, should there be such perfect purification with magnetite in comparison with slow filtration, and the use of other oxidising media? The answer is that the simple magnetic oxide of iron has a far greater purifying action on noxious impurities than when combined with carbon or other metals.

This is due in a great measure to its extreme porosity, on which its magnetic property depends solely. No iron ore possesses the power of *occluding* oxygen from the atmosphere, unless it be a magnetic oxide, and this power varies in proportion to the porosity of the particular magnetic oxide, this practically means that the more porous a magnetic oxide, the greater the power of revivifying itself after it has become exhausted of its oxygen, by contact with organic or inorganic impurities present in foul waters.

Hitherto great difficulty has been experienced not only in producing at a minimum cost an effluent from sewage complying with the requirements of the Rivers Prevention Pollution Act, but manufacturers have been unable to produce a satisfactory effluent from their waste waters, even after the solid matter in suspension has been removed by efficient precipitants. I have filtered manufacturers' waters from dye works, bleach works, and wool scourers' waste (after precipitation) through magnetite, and in every case have produced an effluent equal to spring water in appearance, provided, of course, that the magnetite filter has a sufficient rest allowed it for aëration purposes.

Owing to the ever increasing pollution of our rivers, manufacturers desiring a supply of clean water have been compelled to use town's water at a great expense. I have taken the River Irwell water from Manchester, which is considered the foulest in the civilised or uncivilised world, and after a rapid filtration through six inches of magnetite I produced a clear sweet-smelling water fit for the most delicate manufacturing purposes.

The late Dr. Angus Smith, of Manchester, succeeded in purifying sewage by filtration through a thin slab of new red sandstone, the grains of magnetic oxide of iron present in the sandstone being the active purifying agent.

In conclusion, one of the most momentous questions of the day, especially here in Lancashire, is the purification of our sewage and manufacturers' waste waters, which at last has been rendered an almost absolute necessity in connection with the Manchester Ship Canal, which I visited lately in its non-tidal lengths and which I can only describe as a sink of iniquity. We need no chemical analysis to convince our noses as to its detrimentality to health, we can never, I fear, hope to see it a clear pellucid stream, but we fervently trust that in no great length of time every effort will be made to lessen its numerous sources of pollution. When one considers the millions of inhabitants residing on its tributaries the task appears gigantic, but the sources if taken separately can be dealt with by modern science, and under this category I think that the system of which I have spoken to-day should be included, and moreover, that it is one which will commend itself to your best attention, not only on the ground of efficiency, but also on the question of cost.

[*For discussion on this paper see page* 688.]

"*Lowcock's System of Sewage Filtration,*" *by* SIDNEY R. LOWCOCK, Assoc.M.Inst.C.E.

As a working model of a filter constructed on this system was exhibited in the Exhibition held by the Institute at Liverpool, a description of the principles involved in the construction and working may be of interest.

Filtration was, until recently, generally considered to be a mere mechanical straining, removing the matters in suspension, but it has now been abundantly proved that, besides removing these matters and straining the liquid, a filter under proper conditions also promotes chemical purification of the dissolved organic impurities, and is, in fact, the only commercially practicable method by which they can be removed.

The Local Government Board, in many cases, recognises this fact by insisting on the application of the effluent from any system of sewage disposal to land as a final process.

In cases where works have been constructed without land treatment, the final processes of purification take place in the river or stream into which the effluent is discharged when there is sufficient dissolved oxygen in the water to support them, and the purifying agencies are the same whether the action takes place in the river, in land under broad irrigation, or in a filter.

These agencies are now known from the researches of Messrs. Schloesing and Müntz, Warington, Winogradsky, Munro, and others, to be biological in character and the cycle of operations which takes place when sewage or other manure is applied to porous aërated soil is as follows:—The organic matter is decomposed by the action of micro-organisms and is dissolved and carried in solution into the soil, where it is converted by bacteria in their life processes into nitrites and nitrates, and is then in a fit state to be assimilated by vegetation.

These nitrifying bacteria are the most important factors in the process, and to promote their growth and efficiency several conditions are necessary. Light, air, and temperature, all exert an influence upon them, but by far the most important is air. Perfect nitrification can only be effected in the dark and in the presence of an ample supply of air. Heat up to a certain limit (about 90° Fahrenheit) encourages their growth and efficiency, while cold retards it, although after nitrification is once set up, the temperature, within reasonable limits, does not exercise a very appreciable influence.

Another important condition is the presence of a proper quantity of a salifiable base for the nitric acid produced to combine with, as if the supply of base is insufficient nitrification is incomplete, if in excess, it will not start.

It is, therefore, desirable that the sewage, or effluent, before filtration should be very slightly alkaline so as to provide the necessary base. Time is an important consideration, as the bacteria cannot perform their work instantaneously, and it is evident, therefore, that a sufficient period must be allowed for the sewage in passing through the filter to be sufficiently acted upon. This period will be longer in a new filter than in one which has become accustomed to its work, as a considerable time is occupied in the cultivation of the bacteria, but when once the nitrification has been thoroughly set up the process is extremely rapid.

Although, as already pointed out, nitrification will take place in river water, it will only proceed very slowly unless there is a rapid renewal of the dissolved oxygen, and for this reason nitrification, in a more or less stagnant solution, can never proceed so rapidly as in a solution which moistens an aërated porous solid.

The filter under consideration has been designed to endeavour to promote the necessary conditions in a practical manner and thereby reduce the space required to the smallest possible limits.

The matters in suspension are precipitated from the sewage before its application to the filter, to prevent, as far as possible, the clogging of the surface. The sewage is then run on to the surface of the filter, the top layer of which is of sand which retains any matters left in suspension, and only permits the liquid to pass slowly down into the body of the filter.

After passing through the sand the liquid travels somewhat faster in thin films over the grains of the coarser material below, and thus presents an enormous surface to the purifying organisms and to the air contained in the interstitial spaces.

The air is supplied continuously into the body of the filter by a blower which discharges it through perforated pipes into a specially porous layer in the upper part, from which it is distributed through the whole filter and passes down and out with the purified liquid through the under-drains.

The result of this is that the aëration which is the all-important feature in filtration is rendered entirely independent of the surface, the filter is worked continuously and the depth can be increased and the necessary area thus reduced.

At the same time the ample supply of air prevents the de-oxidizing of the nitrates already formed, a process which, in the absence of air and the presence of organic matter, proceeds far more rapidly than the nitrification process.

Frost does not affect the operation of the filter, except in a very small degree by lowering the temperature and thus reducing the action of the bacteria, as the surface is always covered with a sufficient depth of sewage to prevent its being frozen, and the sewage can pass under any ice formed and down through the filter without hindrance.

The surface is divided up into small areas by divisions extending a short distance below the top layer of sand. The liquid to be filtered can thus be diverted at will from any of these spaces by shutting down the sluices in the divisions, so as to allow of the surface of any section or sections being cleaned, without interfering with the working of the lower part of the filter.

Of course the more efficient the preliminary precipitation the less frequently this cleansing has to be performed, but its neglect does not impair the purity of the effluent. If the surface is allowed to become clogged the quantity passed is reduced, but the time occupied in passing is increased and the purity of the resulting effluent is increased also.

The preliminary tank treatment of the sewage is not particularly referred to as the filter can be worked with any good system of tanks. That shown in the model is merely a modification of the Dortmund Tanks and, as such, calls for no special remark. The only points to be observed are that the chemicals and treatment used must not be of an antiseptic nature, and the effluent leaving the tanks should be slightly alkaline. It is found that with a filter, as shown, 3 feet deep, 100 gallons of normal sewage can be very efficiently purified per square yard per 24 hours, and by increasing the depth of the filter the quantity treated can be proportionately increased.

In the filtration of water as at present practised, the surface only appears to support the purifying bacteria, but the author would suggest that this is because it is the only portion of the filter that can obtain any oxygen, and that by the aëration of the body of the filter, the nitrification can be effected throughout its whole depth. That it does not depend on the mechanical straining effected by a film on the surface is shown by an experiment of the Massachusetts State Board of Health in filtering sewage through a filter composed of gravel stones as large as beans.

[*This discussion applies to papers by* Mr. W. Darley *and* Mr. S. R. Lowcock.]

Mr. Councillor Charles H. Beloe (Liverpool) said he had listened with a very great deal of interest to Mr. Darley's paper, because he practically used the very same words which he (Mr. Beloe) had used himself so frequently with reference to filtration. There was no doubt whatever that it was by the adoption of some porous material—which Mr. Darley called magnetite but which he (the speaker) called polarite—that the work was accomplished. By the latter system he arrived at a satisfactory result in the purification of sewage water. The only point on which he would like to take some exception to Mr. Darley's statement was as to the extraordinary rapidity with which he claimed to have filtered at Heaton Norris. With regard to the other paper he also thoroughly endorsed every word the author had uttered with reference to the advantage of aërating filters in the manner in which he proposed, and he (Mr. Beloe) thought he could show him filters laid down under his supervision almost identical with that spoken of by Mr. Lowcock.

The **President** of the Section: Do you use artificial pressure?

Mr. C. H. **Beloe**: No, but I have used filters constructed in almost the same way as those constructed by Mr. Lowcock, and I can speak of the advantage of the system of aërating filters. With regard to the decolorising powers of magnetite or polarite, it is very remarkable as exemplified in the filtration of the Vyrnwy Water at Oswestry. There is no doubt that where peaty water is used a material of the kind should be introduced, not only for the purpose of removing the colour, but also the peaty acid which has such an injurious effect upon lead pipes.

Mr. **Stenhouse** said that magnetite was a very useful substance if it did all the things claimed for it by Mr. Darley.

Mr. J. **Radcliffe** (Todmorden) asked what became of the poisonous part after passing through the magnetite?

Mr. **Scudder** (Manchester) stated that the table as to the analysis of the raw sewage was very misleading, and he protested against its being placed before the members.

The **President** of the Section (Mr. G. F. Deacon) said it would be unfortunate if it should go forth that the acids which actually exist in the waters used from upland moorlands for water supplies generally were not sufficiently removed by ordinary sand filters to prevent lead poisoning. He had no doubt it was a fact that they could put acids into water which would not be sufficiently removed in that way, but he was speaking of the ordinary waters taken from mountain districts, and in those cases sand filters did prevent the action upon lead which caused lead poisoning.

Mr. W. **Darley** (Basford) said that with regard to the lead poisoning he did not propose to speak of it as an expert, but all he could say was that he had got rid of it, as the lead became insoluble.

The **President** of the Section: That is a totally different thing.

Mr. **Darley** said that the analysis referred to had been made by Messrs. Norman Tate & Co. of Liverpool, one of the first analysts, n no doubt they were able to prove the correctness of ir figures. The error alluded to, however, might be the result of inter's inaccuracy. He entered into friendly rivalry with ite, and they dealt with sewage from foul water chiefly. His had been gathered from experiments actually tried at the works at Heaton Norris, and not so much from anything ected with domestic filtration. Mr. Beloe had submitted that gallons in twenty-four hours went through the magnetite , but it only took half the flow of 240,000 gallons, because the half s filtered through cinders. With regard to the per- ence o urability of the system, it had been in actual work for en mo s and had not wanted any repairing.

COCK having a l, the discussion terminated.

SECTION III.

CHEMISTRY, METEOROLOGY, AND GEOLOGY.

PAPERS AND DISCUSSIONS.

"*The Application of Electrolytis to the Detection of Mineral Poisons*," *by* CHARLES A. KOHN, Ph.D., B.Sc., Lecturer on Organic Chemistry, University College, Liverpool.

ABSTRACT.

THE advances in electrolytic analysis during recent years have had reference to quantitative methods only, and the value of these latter for qualitative work has been to some extent overlooked. These methods are of special value, and can be applied with marked advantage to the detection of mineral poisons in cases of medical and medico-legal inquiries. They do not supersede the ordinary methods of qualitative analysis, but serve as a final and crucial means of identification, and thus render it possible to detect very small quantities of poisons with great accuracy. Amongst the chief advantages are the freedom from contamination with impure reagents and the fact that the methods can be rendered approximately quantitative whenever desired. The application of the methods to the detection of antimony, mercury, lead, copper, and cadmium has been investigated. In all cases it is possible to detect the presence of one ten-thousandth part of a gramme of the metal with certainty or one part in 150,000 parts of solution, this degree of delicacy being considerably greater than it is possible to attain with the ordinary methods employed. In presence of organic matter the electrolytic methods can also be applied, the experiments made on the detection of the above metals in urine having shown very conspicuous advantages both in regard to accuracy and certainty.

The PRESIDENT of the Section (Dr. Thomas Stevenson) said the paper was highly practical and of great importance. He observed present several experienced gentlemen, and he would like to hear their remarks upon it.

Sir **Charles Cameron** (Dublin) rose to express the very high opinion he entertained as to the value of the micrometrical examination for poisons which the author of the paper had brought before them, and had explained in a clear and convincing style. He (the speaker) had very often to make a minute examination for metals in various matters, and he had himself been quite dissatisfied with the quantitative results arrived at by the colorimetrical methods. He had never been quite satisfied that they were accurate. He thought Dr. Kohn had proved his process to be an accurate one, and he (the speaker) should in the next examination he had to make of water or any other material for minute quantities of metals certainly give a trial to what appeared to him an excellent method. It might be considered that the paper was not one representative of the proceedings of the Congress, but he thought from an historical point of view it had some reference to the question of public health. For example, about 300 years ago there flourished a monk, Basil Valentine, who, anxious to improve the condition of his brother monks, tried upon them a substance he had discovered; no doubt against the wish of his brethren, and in fact he dared say it expedited their funeral obsequies by a considerable period of time. The substance whose sanitary effects Basil tried upon his brother monks had ever since been known as antimony, a corruption of antimoine. He (Sir Charles) believed it was no more injurious to monks than to other exemplary societies. It was very desirable to determine minute quantities of antimony in particular organs of the body, as in the liver and kidneys, and in toxological cases no one knew better than the President, who had enormous experience in the determination of all kinds of poisons, that such a process as that described by Mr. Kohn must possess a high degree of interest for the toxicologist. He (Sir Charles) had listened with great pleasure to the admirable paper, and he was sure every toxicologist would agree with him that at all events their thanks were specially due to the Doctor for having brought before them these interesting demonstrations.

Mr. **Edward Davies**, F.C.S. (Liverpool), said that in listening to the paper he was reminded of a mistake made forty years ago in relying upon colorimetrical tests. A sample of water was sent to be analysed, and it was returned from the sulphuretted hydrogen test as containing a given quantity of lead. The reply was sent back that that was scarcely possible as the water only ran for about 18 inches through a lead pipe. A large quantity of water was evaporated, and though he was not quite certain whether it was electrically deposited on an iron wire he did know that copper was the metal which was present. If they had only had Dr. Kohn's method they could have done it more rapidly, and on applying it to the original water have avoided falling into error. The water in question came from Alderley Edge, where it was known that the sandstone was impregnated with copper compounds, and so the origin of the copper was easily explained. Although for some time he had used an apparatus similar to that described by Dr. Kohn in the depositing of copper, still he was very much indebted for the Doctor's details with regard to the deposition of the other metallic poisons. He had great pleasure in seconding the vote of thanks to Dr. Kohn.

Dr. **Alfred Hill** (Birmingham) said he could endorse all that had been said, and add his tribute of admiration to the ability and experience displayed by the author of the paper, and for the very lucid manner in which the results had been placed before them. The paper was so far new, as it went into the determination of minute quantities of metals. No doubt many chemists had applied the method in ordinary analysis, and he had made it a rule to determine copper in solution in an apparatus precisely of that kind which was most delicate and satisfactory. Dr. Kohn had, however, conferred a great service upon them in bringing the matter of minute quantities before them.

The **President** of the Section (Dr. Thomas Stevenson) was sure all would agree in cordially endorsing the vote of thanks to Dr. Kohn. The paper had been to him one of extreme interest, because he had often to endeavour to detect minute quantities of poisons. The information afforded would be of additional interest in guarding the public health, because it was often of importance to the physician and others to be able to ascertain the presence of minute quantities of the various substances in different articles of medicine, especially where only small quantities have to be operated upon, and where great accuracy was desired. It would also be of use to the sanitarian, for they had heard with interest how applicable this method was to the detection of poisonous metals in water, &c. The paper he might state to the uninitiated was of the greatest value to the expert, because Dr. Kohn had minutely described the exact conditions, the amount of current, &c., which yielded the most favourable results. This would be of value to those engaged in these determinations, and they all accorded him their hearty thanks for his interesting paper.

Dr. C. A. **Kohn** (Liverpool), in reply, said he was much obliged for the vote of thanks. He confessed he felt a little compunction in bringing so technical a subject before the Congress. He was glad that so many of the speakers had recognised an old friend in the apparatus he had described. A good many chemists had been frightened from the study of the electrolytic methods of analysis on account of the complexity of the apparatus, but in reality most useful applications of the methods could be made with most simple apparatus. For without setting up electrolytic apparatus on a large scale so as to carry on twenty determinations at once, the little piece of apparatus he had shown would do a good deal of work, and by a little combination could be extended to do two or three determinations at once and thus effect a great saving of time. Two useful books, which he could recommend to any interested in the work, were "Chemical Analysis by Means of Electrolysis" (Classen), translated by Herrick, and "Electro Chemical Analysis," by E. F. Smith.

On "*Hygrometrical Readings taken in Cotton Mills, and their Reductions*," *by* W. W. MIDGLEY, F.R.Met.Soc.

THE observations I have the honour of laying before you are made in consequence of an inquiry as to the state of humidity in cotton-spinning rooms about two years ago. In the absence of any reliable information on the subject I was invited to make some investigations. Most of the hygrometrical readings were taken from December, 1892, to April, 1893, and continued as time permitted down to the present month, and embrace examples of old, intermediate, and modern types of mills. The proprietors gave me every facility for carrying out the observations, and I have no doubt are anxiously looking forward to the publication of the results by Mr. Alderman Dobson, J.P. It would appear that the Royal Meteorological Society has prompted your secretaries to get me to furnish some particulars of the hygrometrical conditions in cotton mills to this Congress. These will be just typical selections of three mills out of the great number visited, and will come upon the members with as much surprise as they did to those who assumed that, with the well-known humidity of the cotton districts of Lancashire, the humidity inside the mills would be something like an approximation of that of the air outside; at any rate, the tables may be submitted as interesting original research from their bearing upon Sanitary Science.

The instrument with which the observations were made was one of the Society's standard pattern of Mason's hygrometer, made by Mr. Casella, London. In every case the exposure was made in the centre of the rooms at 4 feet 6 inches from the floor, and free from any draft of strapping, &c.

The following tables of readings, taken in a large modern mill on December 26th, when the outside temperature was 26°·8 and the relative humidity 87 per cent., give (*a*) the temperature of the mill, (*b*) the temperature of evaporation, (*c*) the relative humidity in the mill, and (*d*), in the fourth column, the amount of humidity allowed by the "Cotton Cloth Factories Act, 1889."

"A."

Room.	Dry Bulb.	Wet Bulb.	Humidity.	Legal.
	°	°	%	%
1	96·4	75·1	33	66
2	102·4	79·6	31	63
3	99·6	78·6	34	64
4	89·3	73·8	42	71
5	83·7	66·7	38	77·5
6	92·0	71·8	33·5	68
7	99·0	75·0	30	64
8	95·6	72·7	30	66

"B."—Another mill, when the outside temperature was 23°·2 and the humidity 94 per cent.

Room.	Dry Bulb.	Wet Bulb.	Humidity.	Legal.
	°	°	%	%
1	83·5	67·0	39	73
2	87·2	71·3	42	71
3	91·5	75·6	43	68
4	85·7	71·8	48	72

"C."—A similar mill, when the outside temperature was 61°·6 and the humidity 87 per cent.

Room.	Dry Bulb.	Wet Bulb.	Humidity.	Legal.
	°	°	%	%
1	84·7	74·4	51·1	72
2	87·7	75·7	52·0	71
3	88·3	75·8	50·5	71
4	88·7	76·1	48·2	71

"A" represents a modern mill in the winter months; "B" an old mill in mid-winter; and "C" an old mill during summer time. In the latter table it will be seen the humidity of the outside air was 7 per cent. drier than when "B" observations were made, while the mean of that in the work-rooms was more humid by 8·5 per cent. This seeming anomaly is explained by the summer temperature being so much nearer to the mill temperature, and therefore able to support a greater weight of aqueous vapour. It should be remembered that air at 32° can only sustain 2·1 grains of vapour per cubic foot at saturation point, whereas at a temperature of 90° it is capable of holding 14·8 grains.

Mr. Marriott, F.R.Met.Soc., in his lecture on "Moisture: its determination and measurement," published in the Journal of The Sanitary Institute for July last, page 206, referred to the Cotton Cloth Factories Act, which in the interests of the work-people fixes the maximum amount of moisture permitted in the workrooms at temperatures varying from 35° to 100°. From the fourth column of figures in the "A" mill it will be seen that the air in the rooms did not contain more than half the legal maximum.

The effect which such an atmosphere must have upon the health of those who have to endure it from day to day is a question I am not competent to give an opinion upon, but one which I think might be discussed by the specialists present. To a stranger to such conditions I can testify that it was very trying, but I suppose that the workpeople have become somewhat acclimatized to it.

I may further add that some firms are trying to improve matters by various forms of artificial humidifying apparatus, some by evaporating troughs, and some by mechanically splitting up the water into fine spray—the latter method, however, has an imperfect effect, inasmuch as the distribution of vapour throughout the room is very irregularly diffused; besides the workpeople are very jealous of any artificial moisture being introduced. It seems to me that the Act of Parliament of 1889 might with advantage, alike to workmen and masters, be supplemented by another fixing the minimum humidity for the spinning industry.

The President of the Section (Dr. Stevenson) said the paper was an exceedingly interesting one, and he hoped some one would take up the question. He himself did not feel competent to speak as to the action of this excessive dryness upon the workpeople engaged in the mills. It might be he had not special knowledge of the subject, that the excessive dryness which Mr. Midgley had indicated was as injurious as the action of excessive moisture in the air. He might mention to those who did not understand the question of dryness and moisture, that it was generally considered by sanitarians that if there was 65 to 75 per cent. of the total moisture which was possible to exist in the air at a given temperature, there was the proper amount of relative humidity. They now heard of as little as 30 per cent. Perhaps someone would throw light on the question of the health of the persons who worked in these exceedingly dry atmospheres.

Mr. G. J. **Symons** (London) desired to express thanks for the good work done by Mr. Midgley. Until he took up the matter it was to be feared that the observations in cotton mills were made in a very unsatisfactory way. He, however, investigated matters, and some little time ago read a paper before the Royal Meteorological Society, calling attention to the Act of Parliament dealing with the subject and the slip-shod way in which the records were kept. The paper he now brought before them was one for which very good instruments had been used, and he gave results from three different rooms, but one point was not clear—he had assumed that everybody knew the provisions of the Act of Parliament. He (Mr. Symons) ventured, subject to Mr. Midgley's correction, to popularise the matter by explaining what he believed to be the history of the legislation referring to the subject. He understood that it was desirable in order to spin efficiently that there should be a certain amount of moisture in the room. It was stated that the workpeople in the mills suffered from the desire of the manufacturers to have a very high temperature and considerable humidity, which was supposed to be unhealthy for the workpeople. The Act was passed by which a maximum limit was put upon the amount of moisture which was to be present in the mills at various degrees of air temperature. The present state of the case he understood was that the result of accurate observations made in these mills showed not that the air was too damp but that it was too dry. Thus they came to the curious contradiction which showed how difficult it was to interfere in these matters. It seemed to him that the masters and operatives might just as well have been left to regulate matters for themselves and that legislative interference in the matter, as in many others, was vicious and, if they could judge from the figures given, entirely in the wrong direction. He was, however, not competent to deal with the matter, but had offered a few remarks which he hoped would be corrected if erroneous.

Dr. **Muir** (Liverpool) took it that after all the object of legislation was to safeguard in some way the health of the people who worked in mills, and his object in rising was not to contribute to the discussion but to ask from the medical point of view whether Mr. Midgley could give any information as to the effect of different humidities upon the health of the workpeople. The scientific aspect of the question was great, but to his mind from a sanitary point of view the health of the workpeople was still more important. If there could be well-founded observations as to the technical defects of the different degrees of humidity, that might be a subject to guide them in future legislation of the matter.

Dr. **Campbell Brown** (Liverpool) rose to ask a question which he said might at first sight appear to have nothing to do with the subject of the paper. Recognising first the fact that life was supported by a process of combustion—that life mainly was combustion, the temperature and moisture in the atmosphere of the mills in the different parts of the world should have great effect upon the health and upon that particular process of combustion that constituted animal life. There was another kind of combustion that often took place in cotton mills, cotton waste frequently took fire. Everyone who had worked in connection with insurance offices knew how desirable it was to know more than we do about the conditions under which cotton waste would take fire, and those conditions were connected with temperature and moisture. He asked Mr. Midgley whether his attention had at all been directed to the effects of temperature and moisture in mills upon spontaneous combustion, or the tendency to spontaneous combustion among cotton waste? If he had, such investigations would be extremely valuable to mill owners, to people whose lives were spent in mills, to insurance offices, and, of course, indirectly to the public generally. The danger of loss of life by fire brings this aspect of the subject within the purview of The Sanitary Institute.

Sir FRANCIS POWELL said he did not speak as an expert either in a chemical sense or as a manufacturer. As regarded the precise figures in the Cotton Factories Act, he might say he had met a gentleman who was responsible for them, Sir Henry Roscoe, who was greatly trusted in the House of Commons when any subject of a chemical character was introduced. He was placed in the Committee to which the Cotton Cloth Factories Bill was referred, and he (Sir Francis) had no doubt that the statistics as appearing in the Bill, if not suggested by him, were in accord with his accurate and well-informed judgment. He (the speaker) felt great surprise on hearing the remarks made as to the want of humidity in cotton factories. In matters of that kind every information stimulated thought. He believed the fact was that in many textile industries there had been great complaint made by the workpeople as to the excessive moisture. That certainly was the case in the linen factories of Belfast, which he had the honour of visiting in former years. There, no doubt, the hands had suffered in years gone by from excessive humidity. The same difficulty had certainly arisen in some of the factories in Lancashire. The floors in many cases were old, and had not only been moist but even wet, and the whole atmosphere had appeared to the visitor highly charged with moisture. He believed there were many processes in the textile manufactures where moisture was necessary. He was told that in the great manufacturing town which had sprung up in the course of a few years—Nelson, in Lancashire—the humid character of the atmosphere was the reason why that enormous development of industry on those hillsides had occurred. In a walk on a damp close day in the autumn with a manufacturer, the latter said "This is a glorious day for us; there never was a finer day for cap-spinning since the world began." That was a homely illustration of the manufacturer's desire to have humidity, and he thought that any feeling on the part of the workpeople in favour of undue dryness might be another illustration of that reaction against the saying that a little knowledge was a dangerous thing. He felt that the paper must cause further inquiries and lead probably to further results. In the course of the last Session of Parliament he heard doubt expressed concerning the figures mentioned in the Cotton Factories Bill, and he was sure after what had taken place that day that more careful investigations must be made and further experiments tried, so that the reading of the paper would lead to valuable results.

Dr. F. E. **Adams** (Medical Officer of Health, Bolton) said he took an interest in the paper, if for no other reason than that the observations were taken in a community of which he had charge. Dr. Muir had asked for some information as to the effect of life in factories upon the health of the various Lancashire towns. He could only answer that question in a general way by stating that in Bolton at any rate the effect upon the pulmonary apparatus was very deleterious indeed. Not many weeks ago it was his duty to ascertain the precise mortality from various pulmonary complaints in the thirty-three great towns of England dealt with by the Registrar-General in his returns. The proportions of deaths from bronchitis per 10,000 of the population was 33 at Bolton and 37 at Liverpool. These two towns were, in this respect, the worst in the kingdom for 1893. He was much surprised to find from the author's able paper that such a low degree of humidity was reached in the factories described by him. He always thought the opposite condition of things prevailed. Medical men, however, would tell them that which ever condition prevailed—an excessive moisture or an extreme lack of moisture—the effect upon the process of transpiration in the lungs would be pretty much the same. The presence of an undue degree of moisture on the one hand, or of an extreme degree of dryness on the other, would so influence the lining membrane of the air passages that transpiration would be impeded, and a tendency to disease would be developed.

Sir **Francis Powell** asked whether, owing to the fineness of the cloth spun, the temperature in the mills at Bolton was not higher than in other manufacturing towns.

Dr. **Adams** said he feared he could not answer that question, and he might mention in connection with his inability to do so that the supervision of the sanitation of factories had by recent legislation been withdrawn from the Medical Officer of Health and placed under the Factory Inspector.

Mr. W. E. **Plummer** (Liverpool) said he was sure Mr. Midgley would not take it as an offence if he asked him whether he was quite sure that the method by which he had determined the moisture in the atmosphere was absolutely accurate and satisfactory to him. As a meteorologist he knew that there were several processes and methods by which that degree of moisture was determined, but he could not say that he found them always absolutely coincident. None knew better than Mr. Symons that there existed various tables by which the relative humidity could be computed, but he did not think they all agreed, and possibly Sir Henry Roscoe might have used different tables to those employed by Mr. Midgley, and that this led in some measure to the unsatisfactory result—if it were such; he did not know it was—and produced the curious result shown. In Liverpool and Birkenhead, which adjoined, they had two communities which had very different death-rates, and they had a means of comparing the relative death-rates for some years back. They had in those two places populations engaged in nearly the same pursuits, and therefore they might anticipate that the climate in each case would have the same effect on the death-rate. As a matter of fact, inquiries going on at Bidston Observatory showed that that was not so. The death-rate in Birkenhead and in Liverpool differed very largely. Taking it throughout the year the relative death-rates were 21 and 27, or a difference of 6 per 1,000 between the two places. Of course it was a very easy thing to ascribe that difference to the unhealthiness of Liverpool, to the great density of population—stated, as he had heard, to be as high as 115 to the acre. The point was this—and it was an answer to Dr. Muir—that the amount of humidity was seen to affect the two towns in an absolutely different manner. It would be found that as the humidity in the two towns increased so the two death-rates approached, and that as the atmosphere got drier so they diverged. The fact remained that at Birkenhead and Liverpool, situated as they were near to one another, at about the same height above the level of the sea, and with populations engaged in practically the same pursuits, an increase of humidity would increase the death-rate in the one town and diminish it in the other.

Mr. W. MIDGLEY (Bolton) said he was pleased with the manner in which the short paper he introduced had been discussed. Mr. Symons was wishful to know why the conditions prevailing in Bolton were not as reasonable a ground for interference, as the condition that prevailed in some other of the occupations in the cotton industry that necessitated the passing of the Cotton Cloth Factories Act. Let him dispossess their minds at once of any point of comparison between cotton spinning and those cotton industries in which it was necessary to fix the maximum of moisture. He quite approved that a maximum should be fixed for the cotton weaving industries. There the main object of the manufacturer in order to produce a good cloth was to have the atmosphere of the mill and of the weaving sheds as damp as possible, or the warp of the cloth would fray by friction, and therefore moisture up to a point recognised by the Act of 1889 improved the condition. In the cotton spinning industry—an industry he had particularly in his mind when making these observations—there were few instances where artificial humidity was in vogue. The humidities of the cotton weaving industry were purely artificial and obtained, some by mechanical processes he had not described, and some by the barbarous process of injecting steam into the rooms—a very disagreeable process for the workpeople. Another way was to wet the floors and allow the moisture to naturally evaporate. But in the cotton spinning industry there were very few mills indeed where artificial humidity was resorted to. They would observe that the very dry readings were taken during the cold of winter—in December and January, 1892—93; and at that time the temperature of the outside air would not sustain more than 1·8 grain of aqueous vapour per cubic foot. That was to say the air on entering the room of the mill only had 1·8 grain of water per cubic foot. By the temperature of the mill that air was expanded but the vapour was not increased, so that though the relative humidity of the air when admitted into the mill might be 90 or 96 per cent., when they got it expanded by heat the relative humidity was reduced by something like 60 per cent. That was the case chiefly in winter time. The dry conditions prevailing in cotton mills should be met by natural evaporation, to make up the humidity to something like 50 or 55 per cent. Where the relative humidity was kept at 52 or 58 per cent., and the temperature at 80° or 82° the workpeople looked livelier, and as could be demonstrated by a microscope the yarn was stronger, and in every respect the conditions were much more satisfactory than where the rooms were so very dry.

The PRESIDENT of the Section (Dr. T. Stevenson) in summing up the discussion, said he hoped that what Mr. Midgley had said would stimulate future research. He himself was very much interested in what Dr. Adams said about the effect of excessive dryness and excessive moisture on the lungs being the same. He recollected an observation he made a good many years ago. They all knew that if gas was burnt in an excessive quantity, people said that a room got hot and caused distress. He had occasion to make some observations on the temperature and humidity of rooms in which a quantity of gas was burned, and to his surprise he found in the upper parts of the room where there was a high temperature a very high degree of dryness; that was to say the relative humidity was small. He begged on behalf of the section to offer Mr. Midgley their hearty thanks for his extremely valuable paper.

On "The Health of the Workmen in Chemical Factories," by A. E. Fletcher, F.I.C., F.C.S., H.M. Chief Inspector under the Alkali, &c., Works Regulation Act.

Under the complex system of life and the civilisation of which we often boast, whereby our many wants are supplied with wondrous regularity, and even the wants themselves suggested, are we sure that there is not a deep countervailing shadow of real wants which are never supplied, and of toil that is but ill requited, existing in the background, hidden from our view? If mechanical and chemical processes have combined to produce results which surpass even the wishes of a century ago, is it certain that the cost in human life and labour is known as well as the result?

These thoughts are suggested by the title of my paper, the more so as recently public attention has been called to the dangers to health to which some of the operatives in chemical works are exposed.

It has been said that "in all labour there is profit"; it is also true that with labour there often is danger. Some occupations are doubtless more dangerous or injurious than others. A list of the dangerous ones would perhaps vary according to the habits and temperament of him who makes it. The perils with which we are made familiar by daily contact lose their terror, while those which are strange to us stand out in exaggerated outline.

Perhaps my own position may be considered as one qualifying me to treat with the subject without bias on either side, having as one of H.M. Inspectors during 30 years been brought into close contact with many classes of chemical works, yet not made so intimately familiar with any one as to lose all sense of the dangers that may attend it.

The following is a schedule of the principal chemical manufactures with a statement of the source from which danger or inconvenience may arise:—

Manufacture or Occupation.	*Source of Danger.*
Sulphuric acid	Acid vapour.
Nitric acid	" "
Hydrochloric acid	" "
Chemical manures	" "
Venetian red	" "

Manufacture or Occupation.	*Source of Danger.*
Nitrate and chloride of iron	Acid vapour.
Sulphate of soda	„ „
Caustic soda	Caustic soda.
Bleaching powder	Chlorine.
Tar distilling	Sulphuretted hydrogen.
Sulphate of ammonia	„ „
Barium compounds	„ „
Strontium compounds	„ „
Antimony sulphide	„ „
Sulphur recovery from Alkali waste	„ „
Bisulphide of carbon	„ „
Felt	Dust.
Flax	„
Hemp	„
Flour or grinding	„
Metal grinding	„
Cork grinding	„
Mining	„
Chromate of soda or potash	„
Fibre separation	„
White-lead	Contact and dust.
Lead smelting	„ „
Lead rolling	„ „
Plumbing	„ „
Type founding	„ „
Type setting	„ „
Pottery glazing	„ „
Enamelling	„ „
Phosphorus matches	Phosphorus.
Arsenic refining	Arsenic dust.
Arsenic colours	„ „
Explosives	Explosion.

This list cannot contain the names of all chemical manufactures from which danger may arise, either from the product itself or a bye-product, but it contains the principal ones, those which from their commercial importance are best known. The dangers connected with many of these trades is so well known and acknowledged that much effort has been made to mitigate them, and in many cases legislative action has been taken to control them, so as to protect the workers and also the general public. The result of the manufacture is in many cases so important or even indispensable to the welfare of the community that there has been no wish to impede its development, but the legislature has insisted that the best practicable means shall be adopted in carrying it on, so that the least possible inconvenience should be experienced from it.

EXPLOSIVES.

From time to time special Acts of Parliament have been passed for the protection of workers in dangerous trades. Prominent among these have been the Explosives Acts, which control the operation and general arrangement for the manufacture of gunpowder and other explosive compounds. The Acts are carried out by an inspector and assistant inspectors, whose duty it is to visit the factories from time to time and insist on the observance of the rules laid down. These deal with the nature of the clothing worn by the operatives, their hours of labour, the position and construction of the buildings, their isolation, the number of operatives employed in each, and in general the control of every detail of the work so as to afford the greatest protection to those engaged in it. Unfortunately even in so dangerous an employment as the manufacture of explosives familiarity brings about disregard of the danger, and the operatives may become careless and neglect to observe the regulations laid down for their protection. From time to time lamentable accidents have occurred. Unfortunately, the witnesses of the calamity are generally the victims, and no opportunity is given for ascertaining the causes.

MINES.

To protect the workers in mines several Acts of Parliament have been framed. These are enforced by inspectors stationed throughout the country. They regulate the construction of the mines, their ventilation, the use of lamps, etc., and investigate every complaint of circumstances likely to conflict with the safety of the miner.

A series of Factories Acts dealing with nearly every form of concerted labour has been framed with a view to the protection of the workers in every detail of their employment. The age of children and the hours of their labour are regulated, the ventilation of workplaces, the fencing of machinery and dangerous places are provided for, and the observance of the rules laid down is enforced by a staff of inspectors under a chief inspector appointed by the Home Office. In these operations the operatives are exposed to mechanical dangers inherent to the work in hand. Some industries are rendered injurious in consequence of the character of the materials dealt with.

Under the Factories Acts special regulations have been framed with regard to the conduct of white-lead works, phosphorus match works, and bichrome works.

ALKALI, &c., WORKS ACT.

The regulation of the more strictly chemical trades, those from which noxious gases may be discharged, comes under the Alkali, &c., Works Regulation Act. This, originally designed to prevent the escape of hydrochloric acid, in the initial steps of the Leblanc process for the manufacture of soda has been extended so as to include most of those processes of manufacture from which the noxious gases, given on the foregoing list, may be discharged.

ALKALI WORKS.

The gases which escape into the air of a Leblanc soda works and are injurious to the workers, are, hydrochloric acid, sulphurous and sulphuric acid, and chlorine. Although the amount of these gases which escape under the restrictions now imposed is not sufficient to be perceived outside the works, yet the workers are more or less exposed to them. With the exception of chlorine, the effect of the gases named is not harmful, when not present in excessive quantity, and men exposed to their action for many years enjoy good health. A strong staff of inspectors under the Local Government Board, each in his own district, pay frequent visits to these works. Using suitable apparatus they withdraw from the flues and chimneys portions of the gases passing away into the atmosphere and by analysis ascertain the amount of acid or other noxious matter contained in it. Heavy penalties are exacted when any is detected in excess of the narrow limits which have been laid down.

BLEACHING POWDER.

The action of chlorine is in a high degree irritating to the lungs and special precautions are taken by those who are exposed to it. The men employed in packing bleaching powder have to remain for a time in an atmosphere highly charged with it. For their protection they wear a respirator composed of several folds of moistened flannel. This kept clean by frequent rinsing in water has been found more effectual than other lighter forms of respirator which have been proposed. Mechanical contrivances for superseding the bleaching powder chamber have been proposed but none have hitherto been found successful, though now that dilute chlorine is likely to be very extensively used, it is possible that such an apparatus may be adopted, an improvement much to be desired, though even then the packing of strong bleaching powder will be an unpleasant operation. The packing of bleaching powder is doubtless the most hurtful of any operation in an alkali work, but several of these packers may be seen who have been so employed for more than twenty years and who still enjoy good health. These are always steady men, frequently total abstainers. In a large number of alkali works, however, the Deacon chlorine process has been adopted and has made the necessity of entering the chambers for the purpose of packing or turning over the powder unnecessary.

Recently some visitors to alkali works, unused to acid gases and the glare of furnaces, have written for the newspapers sensational articles on the unhealthy condition of the operatives, asserting that they are exposed to a destructive demand on their energies, so much so that their health is speedily undermined and life much shortened. According to my experience, and I have had unusual opportunities for observation during the last thirty years, this is an exaggerated statement, and the following statistics, which relate to some of the principal works, do not bear out the allegation. The exposure to the heat of furnaces cannot be called excessive, it is not nearly so great as in iron and glass works: the moderate and occasional exposure to acid gases is not seriously injurious to general health, but indeed may act beneficially as a tonic.

The unnecessary extent to which the men expose themselves to acid gases is often a matter of surprise. On filling the wheelbarrows and removing the hot saltcake from the furnaces to the store, some acid gas is usually thrown off. To prevent this it is the rule to sprinkle some of the cold material on the hot, as this has the effect of at once staying the discharge of gas. So simple a precaution as this is however often neglected, and rather than lift a shovelful of cold saltcake from the floor and scatter it on the load to be removed, the men may often be seen wheeling away a hot charge, surrounded by the acid fumes which might thus have been easily checked. This incident is mentioned here with a view to show the necessity of concerted action on the part of both masters and men in introducing improvements in the conduct of the works.

Caustic Soda.

The caustic soda department of an alkali work is one demanding care on the part of the workers. In the process of manufacture the material is fused in large open iron pans and raised to a temperature exceeding that of melted lead. It is manipulated by means of long-handled iron ladles. Accidents have occurred here in two ways, burns may be caused by a splash from the molten caustic, and still worse, men have in some cases been known to fall into the pans. These sad events have been of very rare occurrence and due usually to want of care, sometimes perhaps to drunkenness. In order to render it in future impossible that men should fall into the pans, a rule is now enforced to the effect that the upper edges of all such boiling-down pans must be at least three feet above the surrounding ground or gangways, and that a clear passage be maintained around them. Formerly the pans were sometimes set so close together as to leave no room between them for a passage, thus making it necessary in passing across the row to step over the narrow ledge of brickwork which separated the pans. In this dangerous position a false step might lead to a sudden accident. Now this danger is removed by the maintenance of a clear footway round each pan three feet below the upper edge.

Another danger to which workers in the caustic sheds are exposed is that of receiving a splash of the liquor on the person or in the eye. The best means of preventing injury from such a source is the immediate application of water, and to this end it is the rule to keep a supply at hand and a syringe charged with water within reach, so that in the rare event of a splash reaching the eye a rapid douche may remove all cause of injury.

Chlorate of Potash.

One of the products of the alkali manufacture is chlorate of potash. In grinding this salt the dust falling on combustible matter, such as timber, clothing, &c., renders them dangerous in case of the application of fire. Minute special rules for the protection of the operatives have therefore been adopted and are enforced by the inspectors under the Factories Acts.

Grinding.

Again in the grinding department of the alkali works the atmosphere is injurious to those exposed to it, in the same way that all suffer who breathe air laden with dust. In this case the dust is carbonate of soda; it is not so injurious as a less soluble material. The workmen may in a great measure protect themselves by a handkerchief drawn over the face.

Nitrous Gas.

Beside the foregoing, which are the dangerous parts of soda works, it must be noted that the times when sulphuric acid chambers, Gay-Lussac and Glover towers, acid tanks, &c., have to be entered for the purpose of cleansing or repairs, there is danger from the inhaling of nitrous gas. An accident of this nature unfortunately has occurred at a chemical factory near London during the month of August last. Two workmen engaged in repacking a Gay-Lussac tower encountered some nitrous gas, which produced, after the lapse of two or three hours, sickness and, in the case of one of the men, subsequent death. Such an occurrence is, however, extremely rare; on inquiry I have not been able to hear of any other similar case. The presence of poisonous compounds of nitrogen has, however, been experienced under other conditions, as where nitric acid has fallen on carbonaceous matter in confined places. Such dangers have usually been successfully avoided by means of the free ventilation of such chambers, tanks, or towers when they have to be entered. Where it is necessary suddenly to enter for a short time places known to contain poisonous gases, respirators containing suitable absorbents may be used, and such appliances are now usually kept ready in chemical works.

In thus enumerating the various dangers which may be met with in chemical works, it must not be thought that they are of constant occurrence; as well might a description of a horse and carriage accident deter prudent people from walking in the streets of our towns. Each vocation in life and each occupation may be said to be beset by its own special danger. From this the chemical manufactories are not exempt.

BICHROME WORKS.

The workers in the factories for the production of the bichromates of soda and potash are liable to a special injury arising from the dust of the dry material. It has a corrosive action on the flesh, and though it cannot injure the healthy skin of hands and face, yet it attacks any place where the skin is broken, causing a sloughing sore, and when taken into the nostrils is absorbed into the membrane and lining of the passages, causing local injury. At such works the men engaged in those portions of the process where dust is unavoidable should guard themselves by plugging the nostrils with cotton wool or by wearing a suitable respirator. A careful attention to cleanliness and frequent washing of exposed parts will prevent all action on the skin or sore places.

SULPHUR RECOVERY.

In connection with alkali works a process has lately been introduced for the recovery of sulphur from the tank waste. The sulphur is liberated in the form of sulphuretted hydrogen, a gas well known to be highly offensive and poisonous. This gas is produced in enormous quantities, so much so that in one of the largest of the alkali works no less than five million cubic feet is generated in the twenty-four hours, but so effectual are the means employed for dealing with it and extracting the sulphur that no accident has at any time occurred to any of the workpeople, nor indeed can the smell of this gas be perceived in the factory.

SULPHATE OF AMMONIA.

The same gas is liberated in the manufacture of sulphate of ammonia, a process carried on at most of the gas works throughout the kingdom. It may now be said that the methods employed for the retention of the sulphuretted hydrogen are so complete that the operators engaged with it receive no injury from its escape, nor is there any passing into the atmosphere so as to cause annoyance in the neighbourhood. It is the more interesting to notice this and the large amount of valuable material yearly produced from the liquor of the gas works, since but a few years ago it was thought impossible to deal with this material without causing nuisance, and much of it was wasted in consequence.

TAR WORKS.

The tar works have recently come under the inspection provided by the Alkali Act. Here there are two prominent sources of noxious gas which operate injuriously on the workpeople employed and on the neighbourhood of the works. These are the uncondensed gases which escape from the end of the still worms and from the hot pitch when discharged from the tar stills. Means are now taken for effectually preventing the escape of these gases, either by absorbing them in suitable liquids, by passing them through oxide of iron, or lime, or by their destruction by fire. On returning to some of these works after the necessary alterations have been made at the instance of the Inspector so that these gases may be prevented from contaminating the atmosphere, I have been met with the thanks of the workpeople, who have declared that the factory was quite another place to work in now that the improvements referred to had been adopted.

FELT WORKS.

Allied to the tar works are those for the manufacture of roofing felt. Many of these are found in Belfast. The felt formed into a continuous sheet is made to pass between rollers through a tank of hot gas tar from which a volume of tar vapour continually rises. As this takes place in closed apartments in which many operatives, both men and women, are employed it is very necessary that the gases should be condensed as otherwise the atmosphere is rendered highly injurious and offensive. Efforts are now made to accomplish this and some success has been met with, but the conditions of the problem render it difficult of solution. The danger of increasing the liability to take fire, adds greatly to the obstacles in the way of success. On behalf of the people employed in this trade, however, it is necessary that increasing efforts be made to improve the atmosphere of these places.

WHITE-LEAD.

Among the processes of chemical manufacture which are injurious to the operatives employed, must be mentioned that for the production of white-lead. The old Dutch method wherein metallic lead is exposed for a lengthened period to the action of acetic acid in a bed of heating tan is still the process in general use. This involves a continued handling by the workers of both the metallic lead and the carbonate or white-lead. Whether lead is absorbed by the skin is still an undecided question. I am inclined to think that the absorption into the system is by means of the stomach. All those who handle metallic lead or compounds containing lead appear to be liable to lead poisoning. Among these may be enumerated workers in factories for the production of white-lead or lead-colours, or those who handle those materials subsequently, as painters and others, those engaged in lead works for the production of lead pipes or sheet lead, workers in lead mines where the carbonate is met with, lead smelters, plumbers, painters, type founders and type setters, enamellers, pottery glaziers. In all these cases the hands soiled by contact with the poisonous material occasionally convey it to the lips. The dust also is taken in by mouth or nostril and thus may reach the stomach. The effects of this insidious poison are the more to be dreaded because they are cumulative, the body does not appear to throw off the poison though taken in small doses, nor does it ever acquire immunity from its action, but the small accessions seem to be stored up until the symptoms of lead poisoning are apparent. So markedly is this the case that an instance is on record where lead poisoning was brought on by the use of snuff coloured with chromate of lead. It therefore behoves those who handle lead or its compounds to practise the greatest bodily cleanliness, to avoid bringing the hand while soiled into contact with the mouth or nostrils, and if exposed to dust containing a compound of lead to keep it, by the use of an efficient respirator, from entering the air passages. Careful rules have been framed and are enforced under the Factories Acts, for the regulation of white-lead works, such as change of clothing &c., but perhaps the most important of these is that for providing the means of washing the hands and face of the operatives on leaving work, and for strictly preventing the partaking of meals in the workroom.

PHOSPHORUS MATCHES.

Another trade which must be classed as noxious to the operatives engaged in it is the phosphorus match manufacture. In this there are two forms of phosphorus used, namely, the common or yellow form and the amorphorus or red form. It is the former only that is noxious. Here again there is no evidence that the poisonous influence is transmitted by absorption through the skin, but it is well known that it may enter the system through the mouth. The particulars of this trade manufacture have recently been the subject of special inquiry by a committee, under the Factories Acts, and remedial measures have been adopted. They are, the avoidance of the vapour of phosphorus in the factories by the separation of the drying stoves from the other working rooms, and the more rapid extinction of the matches which are continually igniting in the packing rooms. Also as in the case of the lead works, all proprietors of match works are compelled to provide washing appliances and the workpeople are enjoined to use them on leaving work. They also are strictly forbidden to partake of meals in the workrooms. As much notice has of late been taken of the disease resulting from the absorption of phosphorus into the system, I have made many attempts to ascertain to what extent it prevails, and am glad to say that I have failed to discover more than three cases which have occurred in the United Kingdom during the last two years. I have seen only one of these, but I have heard of the other two. There seems to be good ground for belief that a strict observance of cleanliness on the part of the operatives, chiefly girls, would prevent the disease altogether. No doubt some individuals are more liable to be attacked by the phosphorus than are others; those who are found to be thus susceptible should cease to expose themselves to it when the earliest symptoms appear.

CHEMICAL MANURES.

A very great improvement in the condition of the operatives has lately been effected in chemical manure works where the manufacture of superphosphate is carried on. The process followed is that of mixing finely ground mineral phosphate of lime with sulphuric acid. The mixture heats and a rapid discharge of a most irritating gas, containing compounds of fluorine, takes place. Until lately this mixing was carried on in open tubs or vats. The men protected themselves as well as they could with cloths tied round their faces and by standing on the windward side of the vat. Since, however, this operation has come under the inspection provided by the Alkali Act, all this has been changed. The mixing is now always done in a closed vessel in which is a mechanical stirrer. From this the semi-fluid material is discharged into a receptacle below, while the acid gas discharged from it is led by suitable pipes to a wash-tower, where, by prolonged contact with water and wet surfaces, the acid is taken out of it. The residual air escapes through the chimney of the factory. In cases where other and more offensive materials are used in the mixture, such as blood, fish offal, &c., the residual air is passed through a fire before being discharged into the atmosphere. The relief which these changes have brought about to the workpeople employed in these factories is very great, and I have often heard the remark made by some of them, "it's a different place now compared with what it was."

In some of these superphosphate works there is much dust in the milling department, where the mineral phosphate is ground, and when the fine powder is transferred to the mixer, but the use of ventilating fans and the adoption of such obvious precautions as should be taken are removing the evil.

FIBRE SEPARATION.

For the purpose of utilising woollen rags a large industry has of late years grown up. The rags are so treated as to separate the fibres and to prepare the wool clean and soft, almost in its primary condition, to be re-spun and woven into new cloth. As, however, many of the rags are portions of garments which have been sewn with cotton thread and may have portions of cotton fabrics attached to them, it is necessary that this vegetable fibre should be removed before the wool is devilled and carded. In order to effect this the mixed rags are exposed for several hours to dry hydrochloric gas at a slightly elevated temperature. This has the effect of charring the cotton without injuring the wool so that now by beating and shaking, the cotton separates as a dry powder. The action of these processes on the workpeople was injurious in two ways. They were exposed to the hydrochloric gas when the rag chambers were opened and to the dust of the pulverised cotton in subsequently dealing with the carbonised rags. Now, however, that this industry has been included among those which come under the Alkali Act, means have been adopted for draughting off and condensing the residual hydrochloric gas and both the men and the machinery in adjacent mills are relieved from its injurious action. As for the dust of the carbonised cotton, that may be kept from escaping into the air by enclosing the beating apparatus and maintaining an inward draught by means of a fan. This is another instance where a small amount of Government inspection has acted most beneficially on behalf of the workpeople.

ARSENIC.

The white arsenic of commerce is prepared from arsenical ores of copper and tin, found principally in Cornwall. These ores are sulphurets of the contained metals. On roasting, the sulphur comes away as sulphurous acid gas, and the arsenic as arsenious acid. To arrest the arsenious acid, the mixed gases, with products of combustion from the furnace, are led through a succession of culverts and settling chambers, in which the arsenic collects while the permanent gases pass on to the chimney. Although by this means nearly the whole of the arsenic is retained, yet some of it escapes into the air, and descends from the chimney-top as a slight shower, resembling snow if colour only is considered.

There has been some difficulty in dealing with this matter. If the mixed gases and smoke were brought to a wash tower with the object of removing the particles of arsenic by a shower of water two evils were brought in. The draught of the furnace was stopped by cooling the smoke before its ascent of the chimney, and secondly the arsenic, if removed by water, would find its way into the streams of the district, carrying a poison with it. A remedy has, however, been found in the use of dry filters, formed of brushwood, iron wire, or other open material. If these are sufficiently large they do not injuriously impede the draught and they retain the whole of the arsenic. They require frequent renewal or cleaning.

The operatives generally in the arsenic works do not appear to suffer from any special form of disease. Those who at times are most exposed to the poison floating as fine dust in the air, as when engaged in removing it from the flues and collecting chambers, or when attending the grinding mill and packing it into casks, take special precautions against inhaling it. They usually plug the ears and nostrils with cotton wool and wear a cloth or wet sponge over the mouth. This, with strict attention to cleanliness, they find to protect them effectually against injury. Doubtless it is safer to work in contact with arsenic than with lead. The body seems able to accommodate itself to the continued absorption of small quantities of arsenic, while the effect of lead is cumulative and causes poisoning sooner or later. I have frequently conversed with men who for twenty-five years have been employed in arsenic works, some of them in the grinding mill, where a constant dust prevails, yet they are hale and hearty—evidently not injured by contact with the poison.

Reference has now been made to the principal chemical manufactures of the kingdom and the sources from which gases are liable to be discharged, which may act injuriously on the operatives, have been indicated. It has also been pointed out that all these gases have been the subject of careful study, and that means have been adopted for preventing or mitigating the injurious action to be feared from them. But it cannot be said that chemical works are places to be chosen for comfort and repose, or that labour there has been freed from the measure of dirt and toil that elsewhere accompany it. The following statistics will show, however, that the amount of wear of health and life in them compares favourably with that in other occupations.

Through the courtesy of the directors of the United Alkali Company I am enabled to print the following tables. They show the number of operatives in the alkali works of Widnes, Lancashire, which is the most important of the alkali making districts; the number of men employed in the various departments of the manufacture, the number of hours of labour, the rates of wages paid, and the relative mortality.

Although the smoke of Widnes, arising from the combustion of one million tons of sulphurous coal annually, and the habits of the poorer portion of the population, combine to render the lower parts of the town unfavourable to the health of the children, yet the general mortality of the place compares favourably with that of other manufacturing towns in Lancashire.

TABLE I.—WIDNES DISTRICT.

NUMBER OF SPECIAL PROCESS MEN AND PERCENTAGE TO TOTAL MEN EMPLOYED.

Name of Works.	Vitriol Burner Men.	Saltcake Pot and Roaster Men.	Alkali.				Bleach.				Sulphur.		Copper Furnace Men.	Total Men Employed.	Percentage of Special Process Men to Hands.
			Revolver Men.	Vat Men.	Finishers.	Caustic Pots.	Weldon Packers.	Deacon Packers.	Lime Dressers.	Still Men.	Carbonator Men.	Claus Kilns.			
Sullivan's	10	8	16	8	18	...	5	...	4	6	2	4	...	510	15·88
Pilkington's	10	36	34	13	...	25	8	...	6	8	4	3	...	630	23·33
Widnes Alkali	12	44	42	16	1	16	6	...	4	4	4	4	...	700	21·85
Muspratt's	8	22	28	9	8	4	2	...	1	2	4	4	...	437	21·05
Gaskell's (Widnes & Ditton)	14	40	32	12	18	2	2	26	6	2	...	...	...	886	17·38
Hutchinson's (No. 1)	2	8	...	...	...	...	...	...	...	...	...	...	...	299	10·03
" (No. 2)	...	...	10	2	10	...	...	...	...	...	...	...	...		
Atlas	6	...	...	...	...	...	3	...	2	2	...	...	...	120	10·83
Mort, Liddell's	...	...	16	11	...	22	...	...	...	...	...	...	...	136	36·17
Liver	...	...	34	12	...	28	...	...	...	...	4	2	...	286	28·00
Mathieson's	12	32	...	...	10	...	6	...	4	2	...	...	...	438	15·07
Golding, Davis	4	12	12	2	...	8	6	...	3	2	6	4	...	282	20·92
Hall & Shaw's	...	...	...	...	...	...	...	...	...	...	4	2	...	100	6·00
Snape's	4	14	...	...	...	...	...	...	...	...	...	...	...	79	22·78
Runcorn Soap	4	8	2	7	4	...	3	...	3	2	...	...	...	369	8·94
Hazlehurst's	4	6	...	...	...	...	...	...	...	...	...	...	...	116	8·62
Wigg Brothers'	6	20	...	...	...	...	4	...	2	2	...	...	18	306	17·00
Western	8	24	...	...	...	...	4	...	2	2	...	...	16	399	14·03
Total	104	274	226	92	69	105	49	26	37	34	28	23	34	6093	18·07

TABLE II.—WIDNES DISTRICT.

AVERAGE HOURS OF LABOUR AND WAGES PER WEEK.

Name of Works.	Vitriol Burner Men.		Saltcake, Pot, and Roaster Men.		Alkali.								Bleach.								Sulphur.				Copper Furnace Men.	
					Revolver Men.		Vat Men.		Finishers.		Caustic Pots.		Weldon Packers.		Deacon Packers.		Lime Dressers.		Still Men.		Carbonator Men.		Claus Kilns.			
	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.	Hours.	Wages.
		s. d.		s. d.		s. d.		s. d.		s. d.		s. d.		s. d.		s. d.		s. d.		s. d.		s. d.		s. d.		s. d.
Sullivan's	84	28 0	74	45 0	74	38 0	54	40 0	61½	40 0	...	......	33	50 0	...	......	61½	31 0	61½	38 0	74	28 0	74	28 0	...	......
Pilkington's	84	21 6	72	42 0	75	41 6	72	41 6	...	......	72	38 0	36	65 0	...	......	60	36 0	65	37 6	84	33 3	84	28 0	...	......
Widnes Alkali	84	36 2	72	45 0	72	46 0	72	39 0	66	42 0	72	46 0	36	64 0	...	......	56	55 0	72	44 0	84	38 6	84	28 0	...	......
Muspratt's	84	35 0	72	45 0	78	36 6	70	33 6	78	42 4	72	43 0	28	50 0	...	......	36	35 0	78	43 0	84	35 0	84	35 0	...	......
Gaskell's (Widnes and Ditton)	56 84	32 8 35 0	72	50 0	78	44 9	78	39 3	78	47 9	84	42 0	36	49 0	36	34 6	72	49 6	78	41 3	...	......	...	......	...	......
Hutchinson's (Nos. 1 and 2)	84	35 0	66	40 0	76	45 3	84	37 0	65	44 0	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	... ..
Atlas	84	35 0	...	......	...	......	...	......	...	......	...	......	30	50 0	...	......	48	37 0	70	37 4	...	......	...	......	...	......
Mort, Liddell's	...	......	...	......	73½	39 0	73½	29 0	...	......	73½	36 3	...	......	...	......	...	......	...	... ..	...	......	...	......	...	......
Liver	...	......	...	......	66	35 6	84	36 6	...	......	84	33 3	...	......	...	......	...	... ..	...	......	84	25 3	60	28 0	...	......
Mathieson's	84	35 0	69	47 6	...	......	...	......	72	45 6	...	......	36	65 0	...	......	72	47 6	72	48 6	...	......	...	......	...	......
Golding, Davis'	84	32 8	64	38 0	74	36 6	78	35 0	...	......	82	38 0	36	60 0	...	......	75	39 0	84	50 0	78	33 0	78	27 6	...	......
Hall & Shaw	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	65	25 5	65	26 8	...	......
Snape's	84	34 6	84	40 0	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......
Runcorn Soap	84	33 3	72	38 0	84	36 0	84	30 0	72	36 0	...	......	36	38 4	...	......	72	20 0	72	29 0	...	......	...	......	...	......
Hazlehurst's	84	31 6	65	38 10	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......
Wigg Brothers	84	30 0	70	40 0	...	......	...	......	...	......	...	......	30	40 0	..	......	66	40 0	72	30 0	...	......	...	......	70	33 0
Weston	84	31 6	72	40 0	...	......	...	......	...	......	...	......	33	38 4	...	......	66	40 0	75	31 3	...	......	...	......	72	33 0
Average	82	32 5	71	42 3	75	39 10	75	36 2	70	42 6	77	39 6	34	51 9	36	34 6	62	39 0	73	38 8	79	31 2	75	28 9	71	33 0

Table III.—Widnes District.

Average Death-Rate per 1000 per Annum (for the last 10 Years).

Name of Works.	Total.	
Sullivan	10·1	
Pilkington	9·5	For the last 8 years
Widnes Alkali	Not known	
Muspratt	7·5	For the last 5 years
Gaskell (Widnes & Ditton)	10·18	
Hutchinson (Nos. 1 and 2)	Not known	
Atlas	5·0	
Mort, Liddell	8·5	
Liver	Not known	
Mathieson	5·25	
Golding, Davis	9·0	
Hall & Shaw	10·0	
Snape	Not known	
Runcorn Soap	7·33	
Hazlehurst	Not known	
Wigg Bros.	4·0	
Weston	11·06	
Average	8·51	

Table V.—Widnes District.

Actual Hours of Labour of Men who work Night and Day Shifts.

Sullivan's Works.

	Vitriol Burner Men.		Saltcake, Revolvers, and Ash Finishers.		B. P. Packers.
	Day.	Night.	Day.	Night.	Day.
Sunday	24	...	...	14	
Monday	10	14	10	14	9 a.m. to 3 p.m.
Tuesday	10	14	10	14	
Wednesday	10	14	10	14	
Thursday	10	14	10	14	
Friday	10	14	10	14	
Saturday	10	14	10		
Total for Week	84	84	60	84	36

TABLE V.—WIDNES DISTRICT—*continued.*

ACTUAL HOURS OF LABOUR OF MEN WHO WORK NIGHT AND DAY SHIFTS—*continued.*

Mathieson's Works.

	Vitriol Burner Men.		Saltcake, Revolvers, and Ash Finishers.		B. P. Packers.
	Day.	Night.	Day.	Night.	Day.
Sunday	24	...	...	8	
Monday	10	14	11	13	6 a.m. to 12 noon.
Tuesday	10	14	11	13	
Wednesday	10	14	11	13	
Thursday	10	14	11	13	
Friday	10	14	11	13	
Saturday	6	18	11	...	
Total for week...	80	88	66	73	36

Widnes Alkali Works.

	Vitriol Burner Men.		Caustic Men, &c.		B. P. Packers.	Saltcake.		Revolver Men.	
	Day.	Night.	Day.	Night.	Day.	Day.	Night.	Day.	Night.
Sunday	24	...	24	...	8 a.m. to 1 p.m. 6 days per week.	18	...	...	12
Monday	10	14	10	14		11	13	10	14
Tuesday	10	14	10	14		11	13	10	14
Wednesday	10	14	10	14		11	13	10	14
Thursday	10	14	10	14		11	13	10	14
Friday	10	14	10	14		11	13	10	14
Saturday	6	18	6½	17½		6	...	6	...
Total for week...	80	88	80½	87½	30	79	65	56	82

Gaskell and Deacon's Works.

	Vitriol Burner Men.			Saltcake.		Revolver and Finishers.		Boiler Men.		Weldon Packers.	Deacon Packers.
				Day	Night.	Day.	Night.	Day.	Night.	Day.	Day.
	No. 1.	No. 2.	No. 3								
Sunday	12	12	...	...	13	...	13	24	...	8 a.m. to 2 p.m. 6 days per week.	Irregular, but about 6 hours per day.
Monday	8	8	8	12	12	11	13	10	14		
Tuesday	8	8	8	12	12	11	13	10	14		
Wednesday	8	8	8	12	12	11	13	10	14		
Thursday	8	8	8	12	12	11	13	10	14		
Friday	8	8	8	12	11	11	13	10	13		
Saturday	8	8	8	11	...	7	11	7	18		
Total for week	60	60	48	71	73	62	89	81	87	36	36

TABLE VI.—WIDNES DISTRICT.

AVERAGE WEEKLY EARNINGS PER INDIVIDUAL.

Name of Works.	Number of Hands Employed.	Average Total Weekly Wages. including Office and Staff.	Average Amount per Individual.	
		£	s.	d.
Sullivan's	550	790	28	7
Pilkington's	630	917	29	0
Widnes Alkali	700	1120	32	0
Muspratt's	437	626	28	8
Gaskell and Deacon's	886	1311	29	7
Hutchinson's	309	428	27	9
Atlas	120	185	30	9
Mort, Liddell's	136	204	30	0
Liver	286	411	28	9
Mathieson's	438	693	31	8
Golding, Davis'	282	624	30	1
Hall and Shaw's	76	93	24	8
Snape's	79	103	26	0
Runcorn Soap	369	489	26	6
Hazelhurst's	118	157	26	8
Wigg Brothers'	306	395	25	10
Weston	399	534	26	9

TABLE VII.—WIDNES DISTRICT.

PARTICULARS OF SICK CLUBS IN CONNEXION WITH WORKS.

Name of Works.	Whether Compulsory or Voluntary Membership.	Committee of Management appointed by	Doctor appointed by	Amount of Weekly Subscription.	Amount of Weekly Sick Allowance.	Amount allowed at Death.			Average Amount of Yearly Dividend for the last 10 Years.	Remarks.
						Man.	Wife.	Child.		
				d.	s.	£	£	£	s. d.	
Sullivan's	Compulsory	Members	Committee	6	10	10	8	2	11 1	Levies made occasionally.
Pilkington's	Compulsory	Foremen	Members	6	10	10	8	2	12 11	
Muspratt's	Compulsory	Foremen	No doctor	6	10	7	5	2	13 8	
Gaskell's	Compulsory	Members	Members	4	8	8	5	...	4 6¾	
Hutchinson's	Compulsory	Foremen	Members	5	8	5	5	1	...	When funds admit the subscription is reduced.
Snape's..................	Compulsory	Members	Members	6	10	5	5	1	16 0	
Wigg Brothers' ...	Compulsory	Members	Members	4	8	4	4	1	35 per cent.	
Atlas..................	Voluntary	Members	Members	6	10	8	6	2	9 9	
Mort, Liddell's ...	Voluntary	Members	Members	6	10	10	8	2	...	Portion of dividend appropriated for excursions.
Mathieson's.........	Voluntary	Members	Committee	6	7	10	5	5	8 10	
Golding, Davis' ...	Voluntary	Members	No doctor	6	10	8	5	...	12 9	
Runcorn Soap.....	Voluntary	Members	No doctor	3	7	4	4	1	25 per cent.	
Weston...............	Voluntary	Members	No doctor	3	7	4	4	1	...	The balance in hand was reserved until it amounted to a total of £500.
Widnes Alkali... Liver .... Hazlehurst's ...	No club	No club	No club	No club	No club	No club			No club	

NOTE.—The Weekly Sick Allowance is usually limited to about six months, when it is reduced about one-half for the following six months. Boys under 14 years usually pay half subscription and receive half allowance.

Through the kindness of Mr. Alexander M. Chance I am also enabled to give tables of the vital statistics of those employed in the works of the Oldbury Alkali Company. Here also it will be seen that the death-rate is low; even among those whose ages lie between 45 and 65 it does not exceed 20·7.

THE OLDBURY ALKALI COMPANY, LIMITED.

TABLE VIII.

VITAL STATISTICS OF MEN EMPLOYED.

	Years 1888—92 and 1893.					
	Years of Age.				All Ages.	
	35—45		45—65			
	1888-92	1893	1888-92	1893	1888-92	1893
Average number of men* employed	477	450	154	145	841	797
Mean death-rate per 1000 of those employed	3·0	0·0	22·7	13·7	13·0	7·5

* These averages are believed to be reliable, but can only be definitely ascertained for 1892 and 1893.

TABLE IX.

CAUSES OF AND AGES AT DEATH DURING 1888—92.

Diseases.	15—	25—	35—	45—	55—	65—	75—	Total.
Lung	1	...	2	1	7	2	2	15
Intestinal	...	1	...	...	...	1	...	2
Brain and Spine	...	...	2	2	1	2	2	9
Typhoid Fever	...	1	...	...	...	...	...	1
Heart	...	...	1	1	1	2	1	6
Cancer	...	...	1	...	1	1	...	3
Phthisis	...	...	...	...	1	...	...	1
Kidney	...	...	...	1	...	...	...	1
Drowned	...	...	...	...	..	1	...	1
Liver	...	...	...	...	...	1	...	1
Senile Decay	...	...	...	...	...	5	5	10
Injury	2	...	...	...	...	...	...	2
Grand Total	3	2	6	5	11	15	10	52

Table IX.—*continued.*

The same for the year 1893.

Heart	...	...	...	1	...	...	...	1
Cancer	...	...	...	...	...	...	1	1
Phthisis	...	1	...	...	...	...	...	1
Senile Decay	...	...	...	...	...	...	1	1
Injury	1	...	...	...	...	...	...	1
Pernicious Anæmia	...	...	...	1	...	...	...	1
Total	1	1	...	2	...	...	2	6

TABLE X.

SPECIAL OCCUPATIONS AND AGES OF THOSE WHO DIED DURING 1888–92.

	15—	25—	35—	45—	55—	65—	75—	Total
Sulphuric Acid process	...	1	...	...	1	...	...	2
Salt Cake process	...	...	1	1	...	3	...	5
Soda process	...	...	...	...	2	2	2	6
Ammonia process	1	...	...	...	...	2	1	4
Sulphur recovery	...	...	...	...	...	...	...	...
Miscellaneous	2	1	5	4	8	8	7	35
Grand Total	3	2	6	5	11	15	10	52

The same for the Year 1893.

Sulphuric Acid process	...	...	...	1	...	...	...	1
Salt Cake process	...	...	...	...	...	...	...	...
Soda process	...	1	...	...	...	...	1	2
Ammonia process	...	...	...	...	...	...	1	1
Sulphur recovery	...	...	...	...	...	...	...	...
Miscellaneous	1	...	...	1	...	...	...	2
Total	1	1	...	2	...	...	2	6

TABLE XI.

NUMBER OF MEN EMPLOYED IN 1892 AND 1893.

Employment.	Number.	
	1892.	1893.
Sulphuric Acid process	70	73
Salt Cake process	55	61
Soda process	177	148
Ammonia process	64	68
Sulphur recovery	21	21
Miscellaneous Work	454	426
Total	841	797

STATISTICS FROM THE SICK AND ACCIDENT CLUB IN CONNECTION WITH THE GLOBE WORKS.

All the persons employed (average 273) are members of the club, and besides receiving sick pay have also medical attendance. The following are the ailments to which the men have been subject during the six months ending 31st March, 1892, and embracing the most crucial period of the year. Comparisons ought therefore to be confined to this period.

It is to be regretted that *data* are not to hand by which a comparison could be made with this and other districts, as to the proportion of the various forms of disease.

Ailments, and Number of Men affected, Six Months ending 31st March, 1892.

Influenza	15	Inflamed Legs	2
Bronchitis	6	Lumbago	1
Congestion of Lungs ...	1	Neuralgia	1
Diarrhœa	4	Rheumatism	1
Epithelial Cancer	1	Tonsilitis	1
Febricula	6		
Gastric Catarrh	1		
Gastritis	1	Total No. of Men affected	41

MORTALITY AND NATURE OF DISEASE FOR FOUR YEARS ENDING 31ST MARCH, 1892.

Fourteen men died during this period. Of this number one man was killed by a crane accident, and in the case of three others no record exists as to the cause of death.

Diseases, and Number of Deaths from each, Four Years ending March, 1892.

Total Number of Deaths.	Death-rate per 1000 per Annum.	Bronchitis	Bright's Disease.	Cardiac Disease.	Apoplexy.	Consumption.	Cancer of Stomach.	Pneumonia.	Typhoid Fever.	Killed by Crane.	Disease not known.
14	12·82	2	2	1	1	1	1	1	1	1	3
Rate per 1000 per Annum		1·832	1·832	·916	·916	·916	·916	·916	·916		

Regarding this, Mr. Wylde the District Manager of the United Alkali Company, remarks; "The death-rate—12·8 per 1000 per annum—compares very favourably with that of the members of the Manchester Unity of Oddfellows, which for the five years ending 1891 is given at 13·9. The Order of Oddfellows may reasonably be said to include all the trades and occupations of British workmen, and it may therefore be concluded that the conditions of health which affect the chemical operative are not more unfavourable than those which obtain generally throughout the different trades of the country."

In submitting the foregoing vital statistics it should be understood that as the numbers are comparatively small, and the period over which they extend is very limited, any conclusions on mortality as affected by occupation or trade which may be drawn from them must be received with reserve. As far as they go, however, they bear out the general experience of those best acquainted with chemical works that the health and longevity of the operatives in them compare favourably with those of the general population elsewhere. From this, exception must be, however, made of those working in contact with lead in any form, or with phosphorous, and those continually exposed to dust, though care and cleanliness on the part of the operative may do much to ward off the threatened danger.

It is very satisfactory to notice how much has been done by the chemical manufacturers to promote the welfare of the men, by providing them with reading and recreation rooms, and by generally ministering to their comfort. Among these may be mentioned recreation grounds in Oldbury laid out by Messrs. Albright and Wilson, and also by Messrs. Chance Bros. for the use of their operatives, also a convalescent home in the neighbourhood, by Mr. A. M. Chance. At St. Helens, Lancashire also, Colonel Gamble, a leader in soda manufacture, has done much for the benefit of the working people in erecting a handsome volunteer hall and by assisting liberally in the establishment of schools. At the same place the late Mr. Kurtz erected baths for the people. A similar boon has been provided for Widnes by Messrs. Gaskell, Deacon and Co. At the works of the United Alkali Company, at Hebburn-on-Tyne, a complete literary institution has been provided for the benefit of the workpeople. The same may be said of several of the gas works as at Leicester, Exeter, &c.

HOURS OF LABOUR.

The work in chemical factories is always carried on day and night without intermission. On Sundays the work, as far as possible, is stopped, but the fires are kept in. The men usually work alternate weeks on the day and on the night shifts, the number of hours of the day-shift being ten, and of the night-shift fourteen. On Sunday, those at the burners of the sulphuric acid department take the double shift of twenty-fours hours once a fortnight.

As might have been expected, these very long hours have produced unsatisfactory results, and trial has been made of the three shift, or eight hours system. The United Alkali Company and Messrs. Brunner, Mond and Co., two firms which together embrace nearly the whole of the soda manufacture of the country, have decided in favour of this system, and have adopted it, as far as possible, with their workpeople. The result has proved highly satisfactory. Messrs. Brunner, Mond and Co. state that, taking for comparison a summer quarter in 1889, before the introduction of the three-shift system, and a summer quarter in 1893, after the introduction; in 1889, the number of those who received sick pay was 7·1 per cent. of the whole, in 1893 it fell to 5·1 per cent.; being a reduction of 28·3 per cent. In 1889, the number of men who were attended by the doctor was 10·1 per cent., while in 1893 it fell to 5·1 per cent.; a reduction of nearly 50 per cent.

It should be noticed that those who received doctor's attendance were probably away from work one or two days. Only those who are away from work for a week receive sick pay. In addition to this the following particulars refer to the holidays granted to the men for regular attendance at their work. They show perhaps still more distinctly the benefit of the eight hours shift. In 1888 those shift-men and day-men who had not lost more than ten days in the year received holidays. In 1893 this allowance was reduced to shift-men to five days.

	1888	1891	1893
Shift-men—			
Percentage who received holidays	43·98	78·7	92·2
Day-men and Boys—			
Percentage who received holidays	59·01	67·5	76·2

These figures show in a striking manner the improvement wrought by the eight hour system in the regularity of the men's attendance at their work, a condition of the greatest importance in chemical factories, where the value of large quantities of materials may be endangered by the absence of the appropriate workman. Also I am informed that the quality of the work done has been greatly improved under this system. One of the masters told me that it was a pleasure to notice the bright elastic step of the men coming to work now, in contrast to the jaded step of past times. Also that under the old system it was constantly necessary to stop men when coming into their work because they were drunk, but now such a thing hardly ever occurs; no man had been so stopped for many months.

At the same time it should be stated that great difficulty has arisen in introducing the eight-hour shift in some branches of the alkali manufacture. Mr. A. M. Chance, writing me on the subject, says:—"Theoretically I am entirely in favour of eight-hour shifts in chemical works, but practically I do not see how the system can be adopted universally, except as the result of gradual and well considered changes." In referring, however, to some new works he is about to start, not alkali works, he says: "These new works will start in a few weeks and I am arranging to place them entirely on eight-hour shifts, as I can readily do so in starting an entirely new concern."

Taking now under review the facts I have cited, it appears that the workers in chemical factories, though exposed to sights, sounds, and smells that may alarm the stranger, have not more than their share of the toil and strain that must ever accompany honest work. They doubtless greatly prefer it to the irksome confinement of the city office or the shop counter, and learn to take a wholesome pride in the productive character of their labour. Much has been done under the Factories and the Alkali Works Acts to shelter them from danger, and their employers have in most cases shown themselves solicitous for their welfare.

From a photograph taken twenty years ago of the men and boys employed at the Alkali Works of Messrs. Harrison, Blair & Co., at Kearsley, in Lancashire, which was shown, they appeared to be fair specimens of healthy working men, and certainly do not support the allegation that the operatives in Alkali Works are liable to an amount of wear greatly in excess of that experienced in other occupations. Several of them were evidently men of advanced age. I have lately learnt that some of the men photographed are living still, and are employed at the same works. One has lately died at the age of seventy, having worked continuously at a salt furnace for forty years.

Two respirators used in chemical factories were also exhibited. The arsenic workers used a piece of sponge which seemed as effective as anything else.

The PRESIDENT of the Section (Dr. T Stevenson) said they were exceedingly obliged to Mr. Fletcher for his able paper, and he hoped some of those interested in alkali workers would express their opinion as to the tables.

Sir CHARLES CAMERON (Dublin) said that owing to the lateness of the hour, and the absence of a large number of members on excursions, the audience was not so large as the importance of the paper demanded. He would first remark that there was a great defect in the paper, Mr. Fletcher had not referred to his own valuable labours in devising many processes for the mitigation of the nuisance which appeared to be more or less inseparable from the great chemical industries. He had not given the faintest reference to that subject, and he ought to be severely blamed. He understood that unfortunately Mr. Fletcher would soon retire from the position he had occupied with such advantage to the public at large, and he would add to the manufacturers, because he was sure that his suggestions, made for preventing the exhalation of gases and other matters from manufactories, must in the long run tend to the benefit of manufacturers as well as of the general public. He was very much struck with what Mr. Fletcher said regarding the indifference to danger which the workpeople in chemical factories exhibited after a time, and to their great detriment. In Dublin he had had some experience in chemical works, more especially where artificial manures were made, and as showing what indifference to danger entailed upon the parties he might mention that he knew of two cases where death resulted through persons entering too soon into what was called the "den" in artificial manure works. Two men died under very painful circumstances, and on each occasion he was called upon to investigate the cause of death, and clearly in the case of one and no doubt in that of the other death was due to the action of silicon fluoride. It entered the lungs and became deposited as silicic acid, and there was extensive clogging of the smaller bronchial tubes. The whole system was poisoned by the fluoric acid. He had tried experiments with the fluoride of silicon. It was an intensely poisonous substance, and animals experimented upon, rapidly died on exposure to small quantities of it. He had only one other remark, and that was with regard to the vital statistics supplied to Mr. Fletcher. The information he had given as regards the various industries must be of great utility to those who studied the influence of occupation upon health. Nothing was of greater importance at the present time in regard to vital statistics than ascertaining the death-rate amongst the various classes of persons, not merely workmen in the factories referred to in the paper, but generally every kind of industrial and professional occupation. Statistics were very much required to illustrate the real unhealthiness of particular occupations. He did not think the statistics supplied to Mr. Fletcher could be very much relied upon, because he noticed that the death-rate among the workers in some of the factories alluded to was excessively low—four per thousand. Such a death-rate was totally unknown, or anything like it, in any class of the population at any age. Their average death-rate if engaged in the healthiest occupation would be certainly two or three times greater than what they saw described in the paper as four or five per thousand.

Mr. A. E. FLETCHER: That is for a limited number of years.

Sir CHARLES CAMERON (Dublin) criticised the statistics as to deaths of the workmen, which he believed in most cases were greatly understated, but did not blame Mr. Fletcher for their inaccuracy as they were supplied to him. They showed that the death-rate in Wigg Brothers' place was only four per 1000. He would say that such a death-rate as that was totally unknown at any age or among any class of people—in fact the only rate that approached what was likely to be the case would be Sullivan's—10·1 per thousand. They ought not to put forward any statement with regard to death-rates except the data upon which the statement was founded were considerable. That was the only criticism that was adverse to this most admirable paper, and he was happy to say on a part of the subject for which Mr. Fletcher was not responsible. He should like to conclude by doing what had been pretty generally done after the reading of the papers, that was to propose that the thanks of the Section be given to Mr. Fletcher. It was a regretable circumstance—of course perhaps it was unavoidable—that the country should soon lose the services of Mr. Fletcher, for as they saw he was now in a better position than in the whole course of his life to be of use. It was a melancholy thing in the interests of the public to say that next June he would cease to discharge the functions which he had carried out—he said it with personal knowledge—with enormous advantage to the public, and with some advantages to the manufacturers themselves.

Mr. E. K. MUSPRATT (Liverpool) said it was with the greatest pleasure that he seconded the vote of thanks for the paper which was a valuable contribution upon an interesting subject. He might also take the opportunity to confirm what Sir Charles Cameron had said as to the valuable services of Mr. Fletcher in generally introducing improvement not only in chemical but in a large number of other manufactures which come under his cognisance. In reply to some remarks made by Sir Charles Cameron upon the question of statistics he would like to remind him and the section that those figures were only statistics upon a special subject, and of course they could not compare the death-rate of 4 per thousand with the general death-rate of the country. But the figures were perfectly correct as far as they went, and anyone who read the paper would clearly understand why the death-rate was so low. The object of those statistics was to furnish a reply to those who stated that workers in chemical works were exposed under exceptional conditions to poisonous vapours which were not conducive to their longevity. So far he thought they were conclusive. It was perfectly certain that they could not have such low figures as they had if the gases existing in well conducted chemical works were really as injurious as they were stated to be. In some conversation he had with Sir Charles Cameron upon the death-rate, especially bearing upon the disputed question of back to back houses, the latter had pointed out very properly that a crucial observation had been made at Saltaire. Sir Charles said that the figures were crucial, for they compared the population living under similar conditions with another, one with a large number in back to back houses, and the other in houses, not of that style, where there was free ingress of air; the figures bore out what might naturally be expected—that where they had through ventilation they had a lower death-rate. He freely admitted that when considering statistics the great point was to consider the death-rate under equal or similar conditions. It was a most striking point in all the figures they were able to gather for the purpose of laying before the Royal Commission, that the artizans employed in chemical works had a higher death-rate than men who were actually engaged in the processes. The men engaged in the processes were more exposed to the gases than the artizans, yet the death-rate among the artizans was higher. That was a very striking result. Of course these figures of the death-rate were not comparable with the figures of the general rate given in the report of the Medical Officer of Health because a very large number of deaths occurred amongst infants under five years of age, and, of course, that raised the general death-rate. The figures given in Mr. Fletcher's paper were of men actually engaged in occupations, and he supposed their ages ranged from twenty to seventy-five years. What chemical manufacturers maintained was this, and the figures bore it out, that in properly-conducted chemical works the men were not killed off at an early age. That they found these men, engaged for their whole lives in chemical works, lived to a fair old age. The figures given showed the death-rate at the various ages. He certainly was surprised to find in the figures given by Mr. Chance a great number of the men were between thirty-five and forty years, and the mean death-rate was given as three per thousand. As a matter of fact the figures showed a large number of men to be of considerable age, and proved that men engaged in chemical works did not die off early.

Sir **Charles Cameron**: They live to an average age of 130 years.

Mr. E. K. **Muspratt**: I cannot say that, I did not speak of averages, but what I do say is that, as far as my experience goes, there are men actively engaged in chemical works who, unless there is a special cause of death, live to a considerable age.

Sir **Charles Cameron**: They never die from Cholera.

Mr. E. K. **Muspratt**: That is another advantage. The statistics from Messrs. Chance's Works were borne out by those of a club that he (Mr. Muspratt's firm) had at their Flint Chemical Works. They had a large number of men on the club books living and receiving at times sick pay. The amount charged was not high, sixpence a week, yet the club flourishes and has a good balance at its bankers.

The **President** of the Section (Dr. T. Stevenson) said he could not help expressing his regret on learning that Mr. Fletcher, whom he had known for many years, was retiring from the public service. His paper was certainly a very valuable one, and he only wished that the statistics embraced a larger number of observations and were more conclusive. He quite agreed with Sir Charles Cameron as to the illusory character of statistics drawn from a small number of men. While Mr. Muspratt was speaking, he looked up the number of men employed at Wigg Brothers. They extended over ten years and the rate was drawn from the deaths of twelve men during the period of ten years. He agreed with Sir Charles that they could not draw any conclusion from that number. He did not doubt the figures being perfectly accurate, but they were illusory as to the real death-rate. In view of the opinion expressed by the general public in regard to chemical manufactories, it was much to be desired that they should have more ample and careful statistics, not only as to the death-rate among chemical workers, but the rate of sickness and the average number of days in a year that men were drawn from this work on account of illness. Until they had these, sanitarians could not draw conclusions as to what was the actual effect of these chemical factories upon the men. He was glad to learn that not only the manufacturers but those who had the supervision of the men were greatly impressed with their healthy character.

Mr. A. E. **Fletcher** (London), in reply, said the number of men given as working at Wigg Brothers was 306, of whom 17 per cent. were process men. That would give about 50 men engaged in the chemical processes, and as regarded the death-rate of 4 per 1,000 the figures showed that in the ten years there had only been one death among them.

Sir Charles Cameron: May I ask whether if that man had not died they would not be immortal, and there would be no death-rate at all?

Mr. A. E. Fletcher replied that of course there would then be no death-rate for that ten years. He thanked them for the vote of thanks, and would remember Sir Charles Cameron's injunction. His own health was a proof that chemical workers were not easily killed off. He had been exposed some hours every day to the vapours of chemical works, and he did not feel any the worse for it.

On "Cold Storage: Its effects upon our food supply," by FRANK TATE, Analytical and Consulting Chemist, Liverpool.

ONE of the chief articles in the dietary of our people is meat. From Table B, given on page 738, it will be observed that meat to the extent of very considerably over 2,000,000 of tons is consumed annually in the United Kingdom. Of this quantity, it will be seen that in 1892 about 67 per cent. is of home production, and that the balance 33 per cent. or about one third is imported into the country, either as live animals for slaughter, dead meat from various sources, or preserved meat (cooked, &c.). That this addition of some 700,000 tons annually to our meat supply is of vast importance to the masses of our people in providing them with a source of food at a price more within their means than formerly, no one can deny, but that this meat shall be put before them in a form which is both wholesome and nourishing is of still greater importance. How the productions of Australasia and America were to be put upon the market in good condition was a problem surrounded with innumerable difficulties, which difficulties it has been the good fortune of the Engineer chiefly, and to some extent of the Chemist, to overcome. As regards the importation of live animals from the United States the magnificent cattle boats, with their rapid and regular passages, of which we in Liverpool are perhaps too proud, have made this not only possible, but a very frequently occurring fact. Of the total consumption of all kinds of meats in the United Kingdom, we see that about 8½ per cent. arrives as live animals for slaughter. But the vast quantities of dead meat imported, require preservation in transport and on arrival, and cold storage has been the means adopted for the purpose.

The question of the most efficient system for the production of artificial cold has been the object of many and varied experiments, but it is only possible for me in a paper such as this, to very shortly refer to these. Speaking generally the production of artificial cold on a large scale, has, after many trials, resolved itself into the adoption of one of four principal methods. These have been conveniently classified as:

1st. Machinery by which a gas is compressed, and partially cooled by suitable media whilst under compression, and further cooled by expansion in the performance of mechanical work as in the cold air machines of Bell-Coleman, Haslam, Hall, Siebe, and Lightfoot.

2nd. Machinery for the abstraction of heat by the evaporation in vacuo of more or less volatile liquids, as in the Ether machines of Harrison, Siddeley, West, and others.

3rd. Machinery for the expansion and compression of condensable gases as in the Sulphur dioxide machine of Pictet, the Ammonia machines of Linde and others, and the Carbonic Anhydride system of Windhausen and others.

4th. Machinery for the evaporation, compression and expansion of gases and their absorption by aqueous solution, such as in the Carre system and its modifications. ✓

Of these various methods those at present in use for the production of cold storage, are chiefly the Linde Ammonia Machine, the Cold Dry Air Compressors, such as those of Bell-Coleman, Haslam and others, and the machines in which carbonic dioxide is used. The machines consist essentially of a powerful compressor pump which compresses the expanded vapours in one set of pipes, the compressed and liquified vapours being allowed to expand in another coil of pipes, which are surrounded on the outside by a solution which is to act as the vehicle for the carriage of the cold, obtained by the expansion of the liquids and vapour, to those places where it is needed. This is only a very rough description, but expresses generally and shortly the principle of these machines. The medium or vehicle used for the carriage of the cold, so to speak, to points distant from the machine, is a solution which remains liquid at a temperature considerably below the freezing point of water. A solution of salt or more generally of chloride of calcium is the one commonly resorted to. This will remain liquid at a temperature of about 5 degrees below zero Fahr. This solution, termed the brine is circulated in contact with the refrigerating pipes before mentioned, in which, by the expansion of the condensed vapours, much heat is absorbed and cold produced, and the brine thus cooled is distributed by means of pipes through the various spaces in which cooling is desired. Any moisture in the air of the rooms is condensed upon the pipes, and the stratum of cold air sinks, and is replaced by a warmer stratum, and in this way the circulation and gradual cooling of the air of the space is attained.

A more recent method is the Lindè patent. In this system the cooled brine is caused to circulate in a shallow trough, in which a number of shafts geared together revolve. Fixed on the shafts are wrought iron discs which as they revolve become partly immersed in the brine. The discs on emerging from the brine take up a thin film of brine over their surfaces, and over these surfaces air is caused to rapidly circulate by means of a fan. The air cooled by contact with the film of brine upon the surfaces of the discs is led through suitably constructed trunks into the chambers of the cold stores, whence it is again drawn by the same fan. In this way all moisture and atmospheric impurities are removed from the chambers of the stores, and washed out as it were, by the brine in which the discs revolve. This system is in use by the Liverpool Cold Storage Company, Limited, and other installations.

Having thus very briefly sketched the methods used for producing and distributing cold, I will shortly describe the Cold Storage in Liverpool, Mr. M. C. Bannister, consulting engineer, and engineer to the Liverpool Cold Storage Company, having kindly provided me with a description of these stores, which amongst others, he has designed.

"The building, as it now stands, comprises a basement, ground floor, first and second floors. The basement contains an ice tank room, two compressor rooms, an engine room, and boiler, chimney, and shaft house. The whole of the principal machinery is contained in the basement, under a fireproof floor. The first, second and third floors are supported on cast iron columns and rolled steel beams. The ground floor is constructed of rolled iron joists, spaced 4 feet apart, filled in with 5 inches of concrete, over which is a layer of 2½ inches of pitch, and over the pitch 9 inches by 3 inches timber joists spaced 12 inches apart with two thicknesses of 1½ inch flooring boards on top securely fastened to the joists, the spaces between the joists being filled in with fine Paisley charcoal, the first and second floors being constructed of two thicknesses of pine tongued and grooved boards. The outside walls of the insulation are constructed of 10 inches by 3 inches principals with 1 inch tongued and grooved boarding inside and out, and the spaces between being filled in with best Paisley charcoal.

"The stores are arranged in sets on each floor, each with its own cooler or refrigerator.

"The chambers are entered from a corridor opening into a passage along the front of the building over the covered cartway where the goods are received and delivered by means of five hydraulic lifts, each capable of lifting 15 cwts. at a speed of 240 feet per minute, to the highest or any floor in the building.

"As many as 9,000 sheep have been taken into the stores off carts, besides some thousands going out of the stores during ten working hours, and with only twenty men to stow and take out the goods.

"As before stated, each floor has a refrigerator outside the store, and only communicating by means of wooden trunks along one side of the stores and overhead. A Blackman propeller draws the air from the stores through timber trunks at adjustable openings, and passes it over a cooler composed of a series of iron discs, which, revolving in a tank of cold brine, are continually presenting fresh surfaces. The air in its passage is cooled by contact, impurities being deposited on the surfaces and so into the brine, which is periodically strengthened. The air then passes back to the store in a pure dry state, cooled to the temperature of the brine in the tank, and very dry, so that the dew point temperature is always far below that of the air in the stores, so that all moisture is rapidly taken up, removed to the brine tank, and there deposited. Usually 8,000 to 10,000 cubic feet of air is circulated per minute through a storage capacity of 50,000 cubic feet, the entire atmosphere being changed, dried, and cooled every five minutes or so. The inlet and outlet air ducts are so arranged that there is always a difference of pressure between the air in the stores and the outside atmosphere, the consequence being that the doors of the stores can be left open during working hours with no great loss of cold, the refrigerator surfaces being always enclosed in a well-insulated chamber, and are always well protected from the outside air. Again, by opening the inlet door of the fan chamber on the refrigerator to the atmosphere for five minutes, the whole of the chambers are recharged with pure air without affecting the temperature of the stores to an appreciable extent, or in any way damaging the roads—a most important point where delicately-flavoured goods have to be preserved, and where a slight smell or moisture would cause a loss of hundreds of pounds to the owners were it allowed to remain in the stores."

Cold stores, such as I have described, in their general principles may be taken as a type of cold storage both afloat and ashore. That these stores have to be kept at a variety of temperatures suitable to the goods stored therein is apparent. Some articles of food require for their preservation temperatures considerably below the freezing point of water, whilst others simply need a temperature which does not amount to freezing, but simply chilling, as in the case of beef.

Meat is not the only food for which cold storage is available, game, fish, cheese, butter, fruit, &c., are all preservable by such means, and considerable quantities of fruit, game, and other produce have been imported in a satisfactory condition not only from America but Australasia.

It may be asked how about quality? I cannot do better than answer in the words of the report of the Committee, appointed by the Government to consider the question of meat marking.

"The Committee desire to draw special attention to the possible effect which any system of marking may have on prices. It is impossible to foretell precisely what may be the result of legislation in this direction, but so far as your Committee are able to judge, any course which would affix to meat an unmistakable mark of its place of origin would, temporarily at least, produce some variation in price, and some dislocation in the trade. At first it is probable that those butchers who have hitherto supplied customers very largely with imported meat would find it necessary to restrict their purchases for a time to home-grown animals, with a corresponding diminution of their own profits. But most of the witnesses agree that as the imported meat became better known, so would it increase in popularity. While the Committee believe that it will be impossible to place before the consumer meat equal in quality to the best that can be grown in these islands, and that consequently such meat will continue to command the top price, they think that there is a large quantity of meat produced in Great Britain of less good quality which is inferior to the beef imported from America, and even to the mutton imported from New Zealand."

"The ultimate result, therefore, might be that meat would come to be divided into four general classes, with considerable variation of price."

"First, the best home-grown meat; secondly, the best imported meat; thirdly, the second class home-grown meat; and lastly, the inferior meat, both home-grown and imported. Whereas the third class now stands in point of price ahead of the second, the indication of the country of origin might transpose their value in the market.

"It was very generally asserted before the Committee that the average excellence of imported meat was higher than that of home-grown meat.

"The Committee think that considerations such as these ought not to be lost sight of by those who are advocating this principle (marking foreign meat) in the interest of the producers of meat in these islands."

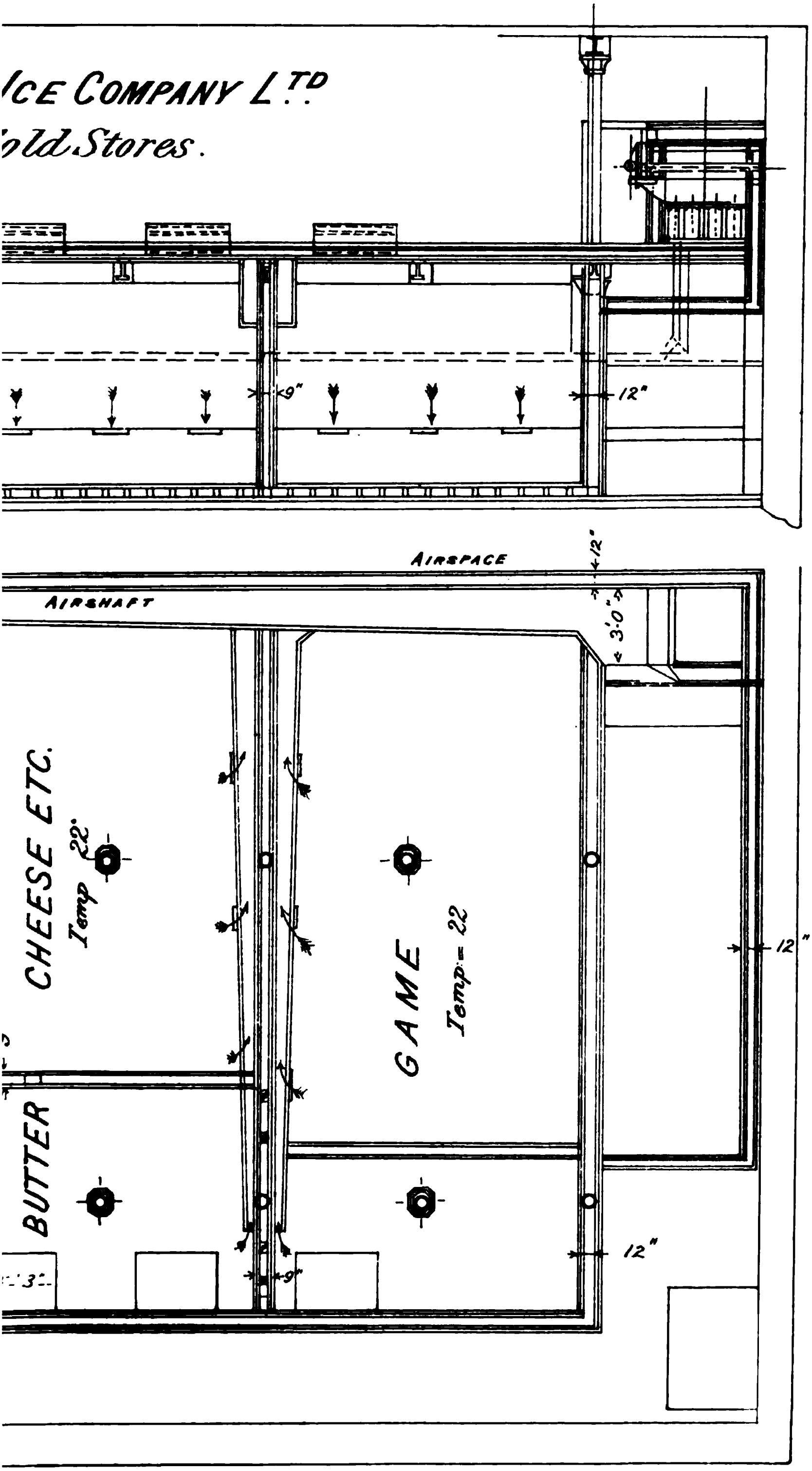
It appears to me that the utility of cold stores in any considerable centre of population is so great that a time will come when a suitable cold storage will be looked upon as a municipal necessity, and no large market for the sale of food will be considered complete without its cold stores. Not only is the establishment of such a very distinct advantage to the population of the town itself but also to that of the surrounding districts. It is useful not only for the purpose of preserving a food supply, but as a source of cheap and good ice.

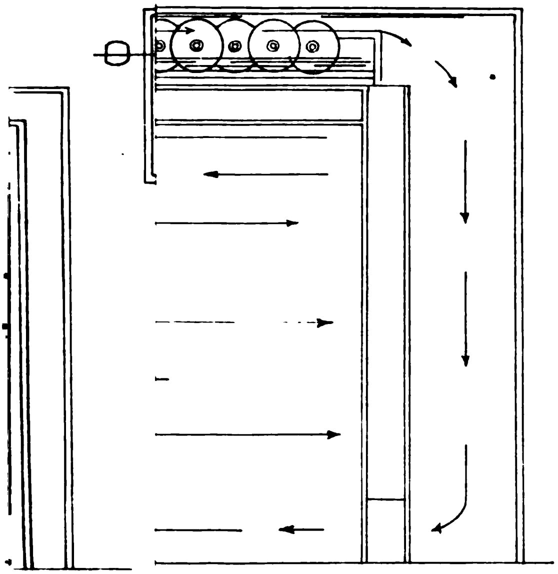
As a specimen of the cargoes imported into this country with the aid of refrigeration, that of the "Perthshire" from Australia and New Zealand to London in the early part of this year is worth noting. The cargo consisted of 70,000 carcases of sheep, 9,000 haunches, 9,000 legs, about 550 tons of frozen beef, 750 cases of butter, 150 bags of bullocks' hearts, 150 bags of ox-tails and kidneys, and 7 cases of oysters. This however was not a full cargo, the ship could have accommodated 12,000 more carcases of sheep.

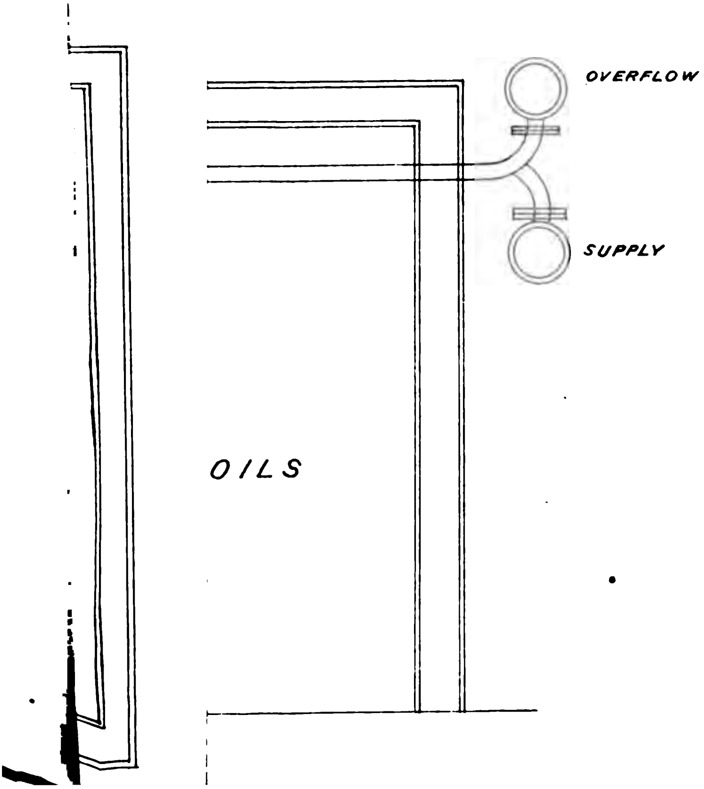
The "Buteshire" arrived in London in June last with a cargo of not fewer than 90,000 frozen sheep, besides 750 tons of general cargo. Three other vessels of a similar capacity are now on the stocks being constructed for the same fleet.

The question of cold stores as a necessary precaution for the accumulation of a food supply in case of siege or war is one that has been deeply considered by the Governments of France and Germany, and I am informed that our own War Office is considering the matter. Quite recently the question has been before the Austrian Government, and experiments have been made which have proved, so it is said, most favourable to cold storage. I need hardly add that if we go "West" we shall find cold storage a well tried institution.

In conclusion, I trust that in bringing this subject before the Congress, I shall not be accused of want of patriotism. Time was, and that not long ago, if indeed it is already past, when the mention of "Yankee beef" or "frozen mutton" called forth expressions of contempt and indignation, and possibly some of the earlier efforts in importation were open to criticism. Even the poorer classes to whom meat was a very occasional luxury, with true British pride and prejudice, approached a Foreign meat shop by stealth and preferred a very doubtful quality as long as they could say that it was "English." As an instance of the effect of prejudice, the following good tale of


ICE COMPANY LTD
old Stores.
9"
12"
AIRSPACE
12"
AIRSHAFT
3'0"
CHEESE ETC.
Temp 22°
GAME
Temp = 22
12"
BUTTER
12"
9"
3'




OVERFLOW
SUPPLY
OILS

Major Stacpole's* is worth repeating:—"I might perhaps, by way of illustration, just mention a case that came under my own observation the year before last at a militia camp. It appears that the mess-president was a great believer in the nutritive qualities of refrigerated beef, and ordered it largely for the officers' mess during the previous training. Some of the officers were against it, and when they assembled again they requested the mess-president not to order any more of that refrigerated beef. 'Well,' he said, 'give it another trial, just another trial.' They dined that night, and said it was undoubtedly good beef, but it had not the flavour of home killed meat. Next night they all declared that there was nothing to beat Herefordshire Ox. The mess-president thereupon informed them that what they had just eaten was refrigerated beef, and on the previous night it was Herefordshire Ox. I can vouch for the absolute truth of that."

Public opinion has very much changed during the past fifteen years, and we find that whereas in 1873–4–5 the quantities of imported dead meats of all kinds consumed per head of population was 12·5 lbs., it was increased to 17·4 lbs. in 1882–3–4, and to 29·6 lbs. in 1891–2. One firm of importers has to-day about 600 shops for the sale of American chilled beef and frozen mutton, and there are at least 2,000 to 3,000 shops almost exclusively engaged in selling imported meat in the United Kingdom. Instead of looking upon all imported wholesome food with suspicion, and as an invasion to be resisted, I hope I have said enough to show that in foreign supplies and cold storage we Britishers have true allies, and that he is not the patriot who, with insular prejudice, preserves special interests, but rather he who welcomes the coming of any process which helps to enrich the dietary of our population with sound food, and thus promotes the "Health of the People."

Table A.

	Number of Vessels.	Carrying Capacity each Voyage.	Maximum Annual Importing Capacity.
		Carcasses.	Carcasses
Australia and New Zealand to London...	4 Sailers......	57,000	57,000
	63 Steamers ..	1,974,800	4,870,000
River Plate, &c., to London, Liverpool, &c.	21 „ ...	612,000	1,773,000
	88 Vessels.	2,643,800	6,700,000

---

* Minutes of Evidence Enquiry *re* Meat Marking (p. 54). Major Stacpole, of the Army Service Corps, in answer to question No. 948.

TABLE B.

Description.		Sources of Supply.	Quantities. Dead Meat.	Dead and Preserved Meat.	Live, Dead, and Preserv'd Meat.	Total Supply of each description of Meat.	Percentage of Frozen Beef and Mutton.	Percentage of Imported Beef and Mutton.	Percentage Annual Consumption all kinds of Meat.
			Tons.	Tons.	Tons.	Tons.			
Beef and Veal.		Home Production	...	...	771,000	...	...	...	36·40
	Imported.	Live Animals	...	...	176,000	...	...	...	8·30
		Dead Meat:—							
		United States	95,000	...	...	...	...	2·00	4·50
		Australia	5,000	...	...	...	62·50	4·60	0·20
		New Zealand	2,000	...	...	...	25·00	1·80	0·09
		Argentine Republic	1,000	...	...	...	12·50	0·80	0·05
		Sundry	1,000	...	...	...	...	0·80	0·05
				104,000					
		Preserved	...	42,000	...	...	...	...	1·98
					146,000				
						1,093,000	100·00	100·00	
Mutton and Lamb.		Home Production	...	...	421,000	...	...	...	19·80
	Imported.	Live Animals	...	...	2,000	...	...	...	0·09
		Dead Meat:—							
		United States	...	...	...	...	...	...	...
		Australia	8,000	...	...	...	10·95	9·50	0·35
		New Zealand	43,000	...	...	...	58·90	49·50	2·02
		Argentine Republic	22,000	...	...	...	30·15	26·00	1·03
		Continent	9,000	...	...	...	...	11·25	0·42
		Sundry	3,000	...	...	...	...	3·75	0·15
				85,000					
		Preserved	...	3,000					
					88,000				
						511,000			
							100·00	100·00	
Pork, &c.		Home Production	...	...	227,000	...	...	...	10·70
	Imported.	Dead Meat:—							
		United States	252,000	...	...	...	...	...	11·87
		Continent & Sundry	39,000	...	...	...	...	...	1·85
				291,000	291,000				
						518,000			
						2,122,000			100·00

TABLE C.

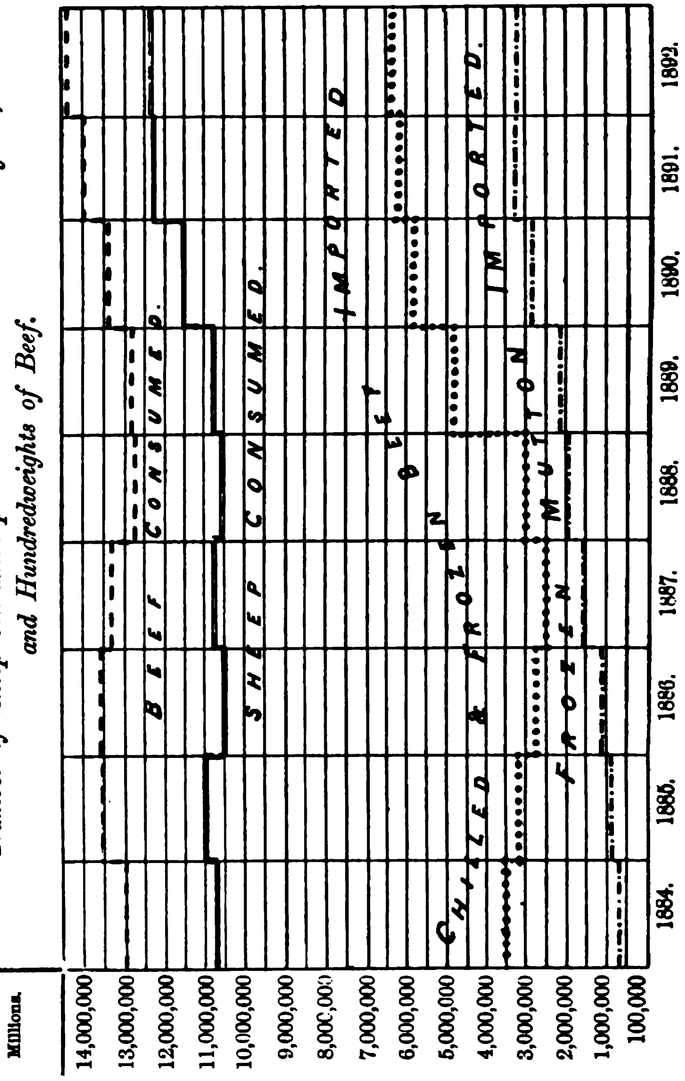
IMPORTS from UNITED STATES & CANADA to the MERSEY, for WEEK ENDING SEPT. 22nd, 1894.

	Cattle.	Qrs. of Beef.	Sheep.		Cattle.	Qrs. of Beef.	Sheep.
Queensmore	655	1552	...	Sarnia	337	...	700
Lake Superior	589	...	...	Germanic	...	1800	...
Georgian	840	2420	...	Aurania	...	3841	...
Rappahannock	359	...	...	Barrowmore	625	...	900
Mongolian	435	...	...	Nomadic	744	2250	...
Templemore	887	...	...	Lake Winnipeg	385	...	...
Southwark	...	840	...	Etruria	...	1840	...
Michigan	658	2824	587	Ottoman	702	1718	...
Cephalonia	...	1492	...				

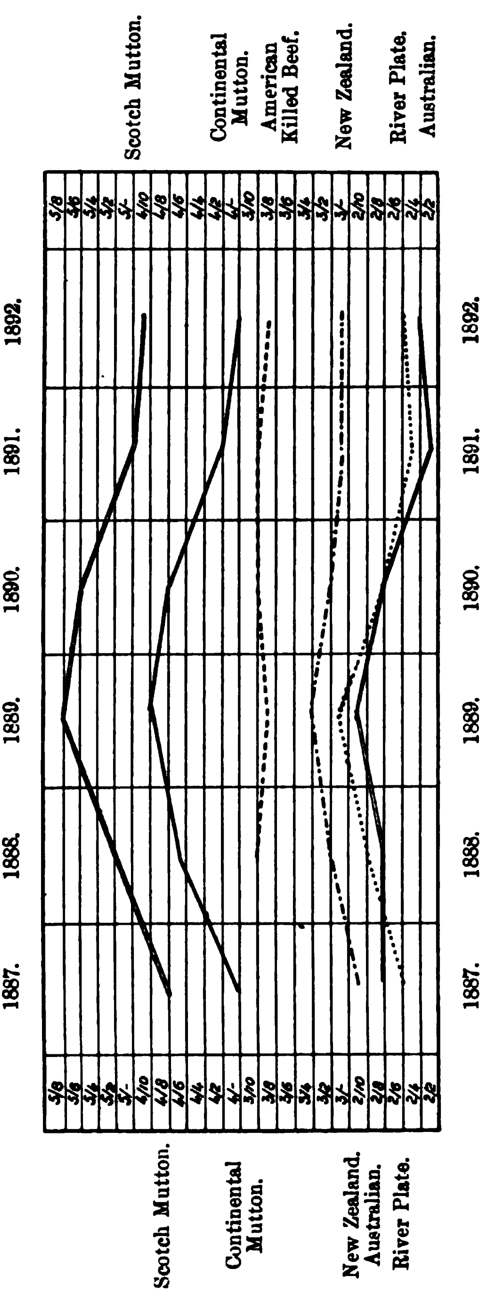
Cold Stores throughout the Country.

London	The Linde British Refrigeration Co., Shadwell Stores	General and Eggs.
„	Messrs. Nelson Bros.' Stores, Nelson's Wharf, Lambeth, and Upper Thames St.	Sheep.
„	Blackfriars Stores	„
„	Leadenhall Market Stores	General.
„	Army and Navy Co-operative Co. Stores.	„
„	Smithfield Market Stores	Sheep.
Birmingham	The Linde British Refrigeration Co., Cold Stores, Fish Market	General.
Cardiff	Cold Stores	„
Swansea	Cold Stores (not completed)	„
Manchester	Corporation Cold Stores, &c.	„
Liverpool	Liverpool Cold Stores and Ice Co.	„
„	James Nelson & Sons	Sheep.
„	Sansenena & Co.	„
„	Eastmans, Ltd.	„
„	Vesty & Co., Bootle	„
Newcastle	Cold Stores and Ice Co.	Chilling.
Leeds	Cold Stores	General.
Belfast	Cold Stores and Ice Co.	„
Cork	J. & J. Lonsdale	Butter.
Limerick Belfast Waterford	Denny's Stores	Pork.

Number of Sheep consumed per annum in the United Kingdom, and Hundredweights of Beef.



Fluctuations in Value of Frozen Meat, &c., during the Six Years 1887—1892.



Sir **Thomas Crawford** (London) said that though very familiar with the use of frozen meat, he had not before heard of the admirable manner in which it was dealt with on its journey to this country. In London they had been, as was generally believed, supplied with the thoroughly sound home-produced article, but eventually they found that the butchers were in the habit of getting the "home-grown" from some of the firms who imported foreign frozen meat. He had himself been in the habit of using this meat in his own family, and could speak with the greatest confidence of its quality and with satisfaction at the prospect of having such an addition to the meat supply of this country. They were largely dependent on imported food, and it was of the greatest interest to them to know the manner in which that food was preserved, and to be well-advised as to its character and the treatment it received. For that reason he wished to thank Mr. Tate for being good enough to give them so valuable a paper.

The **President** of the Section (Dr. T. Stevenson) desired to offer the thanks of the meeting to Mr. Tate for his interesting paper. It was of especial interest to him because a few years ago he belonged to a well-known club in London where they prided themselves on their "haunches of mutton." He followed up the matter and found that the meat came from a shop where it was known as "New Zealand four-year old."

Mr. **Tate** (Liverpool), in reply, suggested that all present should read through the Minutes of Evidence of the Committee of the House of Lords, which inquired into the question of the marking of foreign meat. They would find there more information about food than they had in his paper.

"*The Atmosphere of Liverpool*," *by* T. LEWIS BAILEY, Ph.D., and CHARLES A. KOHN, Ph.D., B.Sc.

ABSTRACT.

THE investigator of the air of towns, especially in its relation to both animal and vegetable life, is essentially concerned with the examination of the impurities present in the atmosphere as apart from what may be considered as the normal constituents of air—oxygen, nitrogen, carbonic acid gas, and moisture. These impurities arise essentially from the combustion of fuel, and consists of sulphurous and sulphuric acids and particles of carbonaceous matter suspended in the air. In addition there are moulds, germs and liquid organic products of the nature of which very little is known. The work done in Liverpool, which is only the beginning of a wider series of experiments, has consisted chiefly in the determination of the total sulphur

present as sulphurous and sulphuric acids, and a few determinations of the organic matter. These determinations have been conducted at two stations, one almost outside the city (University College), and the other in a more densely populated neighbourhood and near the river Mersey (Vauxhall Road). The method employed was similar to that used by Dr. G. H. Bailey, who has carried out a long series of experiments on the impurities present in the air of Manchester, except that the meter employed for aspirating the large volume of air required for each determination was driven by an electric motor instead of by a weight attached to a cord running over a pulley. This alteration has several advantages, rendering the apparatus practically automatic. The following are some of the results obtained, expressed as milligrammes of sulphur dioxide per 100 cubic feet of air.

TABLE I.

Comparison of the amounts of SO_2 in Air in clear and in foggy weather.

STATIONS :— *University College.*

	Milligramme SO_2 per 100 cubic ft.
Thick fog (November)	3·5
Slight fog (December)	1·7
Fog over river (November)	0·5
Fog over river (January)	0·96
Clear (December)	0·30
Clear (June)	0·20
Vauxhall Road.	
Fog (February)	9·1
Clear (February)	0·58

In Manchester 12·0 milligrammes SO_2 per 100 cubic feet were found during a thick fog in December, and 21·0 during a very thick fog.

At the Vauxhall Road Station the following average amounts of sulphur dioxide were found from February to June.

TABLE II.

STATION—*Vauxhall Road.*

Month.	Average milligrammes SO_2 per 100 cubic ft. of air.
February	6·47
March	1·91
April	1·53
May	0·95
June	0·33

The observations were made between November and June, 1893-4. They are to be regarded only as preliminary results, and it is proposed to establish five stations in all for the completion of the work. Meanwhile the results point to the marked purity of Liverpool air as compared with that of Manchester or of London, as well as to the greater proportion of sulphurous and sulphuric acids present in the more densely populated parts of the city.

[*For discussion on this paper see page* 749.]

"*Notes on Town Smoke*," *by* HUBERT L. TERRY, F.I.C.

IMPOSSIBLE though it is not to admire the zeal with which sanitarians in many of our large towns have thrown themselves into the task of abating the smoke nuisance, it is at the same time difficult for the technical chemist or engineer to treat with seriousness every one of the various schemes which have been put before the public to effect the end in question. Some of these schemes have been advocated by those who were familiar with the chemistry of combustion, others, alas! by those who were not; and in both cases the dry bones of discarded processes have constantly been rehabilitated with such effect that the casual reader, not conversant with the bibliography of the subject, has been apt to imagine that the latest patentee who appears on the scene has really overcome all difficulties. The following notes, for which no great originality is claimed, may possibly aid somewhat in dispelling the haze which, in accordance with the fitness of things, surrounds the subject in the minds of many.

Coal may be generally stated to consist of one-third volatile matter and two-thirds fixed carbon, and the immediate result of adding fresh fuel to a hot fire is to distil off the volatile matter in the form of hydro-carbons, of which olefiant gas and marsh gas may be taken as representative. Now it altogether depends on how far the conditions are favourable for complete combustion as to how much of this gas escapes up the chimney unburnt as grey smoke, or how much is burnt to carbonic acid and water. Fuels require a certain amount of air for their combustion, but the theoretical quantity required by coal has to be doubled in practice to counteract the effect of the products of combustion on the fire. About 300 cubic feet of air would therefore be required per pound of coal, but the difficulty is to distribute this air just as it is wanted. The combustion equations of marsh gas and coke show that double the quantity of air is required for the former as for the latter, and it is because our fireplaces and furnaces have no means for regulating the air supply to the requirements of the fuel, that we have so much trouble with smoke. The example of a colliery explosion of fire-damp* shows us that the hydro-carbon can be burnt under suitable conditions without the production of free carbon.

These conditions are:

(1) The proper amount of air.

(2) Due admixture of this air with the combustible gases.

(3) A sufficiently high temperature.

The prevention of smoke postulates these conditions, but, as we shall see, it is difficult to obtain them.

In the case of the household grate there is frequently a deficiency of air entering below, and a large excess drawn in over the top of the fire by the chimney-draught. This latter causes rapid cooling of the hydro-carbon vapours as they are evolved from the coal, and reduces them below the temperature of combustion; it also, by cooling the flames, causes deposition of soot. In the boiler fire, on the other hand, the conditions are different, and it is possible by careful firing to regulate the air supply to some extent. Moreover, the smoke is given off just after firing, or when "breaking up," and not over a long period of time as in the house fire. With regard to the temperature requisite, it is known that hydrogen combines with oxygen to form water at about 600° F., while carbon requires a temperature of 800° F. before it burns to carbonic acid. Now the separation of free carbon or soot may be explained as due to one of two causes, which may tend to reduce the gases to a temperature which is sufficient to burn the hydrogen, but not the carbon. These causes may be a large excess of cold air entering the fire, or the sudden addition of a large quantity of fresh fuel. The volatilization process is an extremely cooling one, and results in the sensible heat of the fire becoming latent to a large extent. A separation of carbon from the hydro-carbon may also be brought about by a deficiency of air, as the hydrogen has the greatest affinity for the oxygen, but it is difficult to imagine this as likely to occur at all often.

To more than glance at what has been done in the way of providing smoke-consuming appliances would entail greater prolixity than the present occasion allows. The published results of the Smoke Prevention Committee of St. Louis, U.S.A.,† are of considerable interest as combating many pet notions of engineers. From them we learn that a smokeless chimney represents a loss of efficiency of 13 per cent. compared with a moderate evolution of smoke. I cannot stay longer over this report, but it should not escape the notice of those interested. I am not aware that the influential association that was formed some three years ago in this country to investigate the merits or otherwise of smoke-preventing appliances has issued a final report, but a branch committee at Glasgow has done so, and among the recommendations are (*a*) the better education of firemen and (*b*) the more general use of mechanical stokers for dirty coal. To my mind those inventors who have aimed at supplying hot air at the fire-bridge, or at burning the separated carbon by passage through incandescent fire-brick, are most likely to achieve permanent success. Differences of opinion exist among steam-users as to the merits of this or that appliance, but the fact is, that boiler settings vary a good deal, and an appliance that will work well on a modern boiler with good draught will probably fail in a case where the flues are long, narrow, and half full of water. The more extended use of modern high-pressure boilers is all on the side of the smoke reformers.

---

* $CH_4 + 2(O_2) + 8(N_2) = CO_2 + 2(H_2O) + 8(N_2)$.

† Proc. Inst. Civ. Eng., 1892-93.

It is frequently urged that a smokeless chimney is an indication that the poisonous gas, carbonic oxide, is being evolved. Now I confess to a feeling of scepticism as to this being at all generally true. That the gas is never produced by a fire I do not assert, but it is rarely the case, and it would be difficult to account for its presence in the average chimney where air is always in excess. Angus Smith,* moreover, points out that he only found carbonic oxide in black smoke, and this statement, taken in conjunction with recent published analyses, should, I think, warn us from attaching too much prominence to the assertion that carbonic oxide is a necessary concomitant in the case of a smokeless chimney.

I shall now refer to some remarks made by Dr. Oldfield when discussing a former paper of mine.† He suggested that as the Alkali Acts had proved of great service in preventing injury to the country by mineral acids, similar legislation was only needed to do away with the smoke nuisance. Now with all humility I venture to submit that from a chemical point of view the identity of relations demanded by an analogy is in this case conspicuously absent. There is little in common between the constituents of black smoke and hydrochloric acid gas. The latter is readily soluble in a stream of water, and can be removed from air by simple washing. In the case of smoke, filtration of some sort would be necessary, and this, although it has been done in more than one case, is found difficult to carry out in practice. Dr. Oldfield also inclines to the opinion—and he is by no means alone—that a general recovery of tar and ammonia from the coal we burn would be a desirable thing to bring about. Now my objections to any such scheme are, firstly, in the case of tar, that in the ordinary grate or boiler fire no tar of the benzine series—which alone is of value for colour making—is produced.

---

* Ann. Rep. Alkali Acts, 1867.

† Trans. San. Inst., 1892.

This point has been insisted on by Mr. G. E. Davis and others who have shown that the tar produced belongs to the paraffin series of compounds. But supposing this difficulty to be overcome, we have to consider what market there would be for the benzine recovered from this source. Already the large recovery of this body from closed coke ovens and from coal gas in Germany has resulted in a great reduction of prices. A paper by Dr. Dreyfus* shows that benzol, which was quoted at 4s. 8d. per gallon in 1891, had fallen in 1892 to 2s. To-day it is quoted at 1s. per gallon, which, if figures mean anything, surely indicates that the supply already exceeds the demand. I mention this especially because the carbonization of coal in closed ovens, with the object of supplying gas and coke for house fuel, is advocated on the plea that considerable profits must result from the sale of by-products. To turn now to the ammonia, if we take the nitrogen in coal as averaging 1 °/₀ this would represent about 200 lbs. ammonium sulphate per ton of coal. In practice however, under the most favourable conditions, it is found difficult to recover more than one-tenth of this quantity. The fact is that if coal is properly burnt in a current of air, the nitrogen is evolved in the free condition and not as ammonia at all, and it is only where steam is introduced, as in the Young and Beilby shale retort, that any quantity of ammonia is obtained. That the supply of ammonia yet exceeds the demand or even satisfies it I do not wish to imply, but I am not at all sanguine as to the supply being augmented from fireplaces as built at the present time.

Dr. Oldfield suggested further that it was advisable to fix a limit at which black smoke is to be considered harmful, and then to legislate accordingly. He cites the cases of chimney sweeps and colliers as showing the danger to health, resulting from the presence of carbon in the respiratory organs. I have no particular knowledge of chimney sweeps, but with regard to colliers I have more than a suspicion that this statement involves the fallacy of *post hoc ergo propter hoc*, because the probability is that the damage is due to the coal dust consisting of angular particles, the chemical composition of which is a matter of small moment. I do not say that the presence of amorphous carbon as found in black smoke and soot can be at all beneficial, but I think we want further evidence as to its inimical action on the lungs. To return, however, to the question of a fixed standard for black smoke, I think that any such enactment would be unsatisfactory unless it was clearly laid down that manufacturers would be under the inspection of qualified men as in the case of the successful Alkali Act. Each district should be treated on its own merits. An amount of smoke which would strike terror into the mind of an inhabitant of the Isle of Wight, would be taken as a matter of course in the Potteries, and there would be no advantage in making both districts amenable to one standard. The qualified inspector who appears in my visions of the future will have under his consideration the question as to whether black smoke is necessary or superfluous in any particular case, and he will then instruct the local authority to administer the law as laid down by the Public Health Act, 1875. Draconian legislation such as that proposed, would serve to harden the hearts of the offenders, whereas it should be our purpose to secure their co-operation. The advocate of a Fabian policy in these days meets with but scant sympathy, but the country may wake up some day to the fact that such a bulky statute book as that which is now in progress of formation, is not altogether an unmixed blessing.

---

* Journ. Soc. Chem. Ind., 1892.

The remarks made by Dr. Black in the discussion under notice, where he referred to the remissness of urban authorities in certain towns were very much to the point. It is a matter of common notoriety that in some towns, and where the law is rigidly enforced against mill owners, the amount of smoke emitted by warehouses, hotels, etc., is a decided nuisance. The heating arrangements in such buildings are often badly designed and under the management of incompetent hands. Again, the tendency to save the expense of a sweep by firing the soot in the chimney is looked upon with much more leniency in some towns than should be the case.

With regard to the smoke question generally in our large towns, there does not seem much likelihood of the two alternative schemes which aim at doing away with the use of bituminous coal being adopted to any extent in the near future at all events. These alternatives you know, of course, to be (1) gas, (2) anthracite. The arguments for and against these proposals have been before the public for some time, and the exigencies of space will not permit of my recapitulating them, but anyone who has studied the matter must own, I think, that the adverse opinions which have been expressed have a good deal of foundation in fact. I myself think that the solution of the question lies rather in the direction of improved fireplaces, in which to go on burning bituminous coal, than in the radical change suggested. The boiler question is not such a very difficult one, but to evolve a perfectly satisfactory household grate from the combination of the various improvements, which have been so far effected will yet require, I think we must all admit, the inventive faculty in its supremacy, if not in its highest perfection. To cry out for an improved household grate may seem at first sight somewhat like straining after the proverbial gnat, but the fact is figures recently obtained by Dr. G. H. Bailey which show conclusively that in one large manufacturing town at all events the greater portion of the smoke nuisance arises from the household chimneys. It would, of course, be hazardous to generalize from one set of observations, as similar conditions are hardly likely to occur in any two towns, but the figures obtained by the observer quoted should receive due recognition. To overcome the conservatism of the domestic servant is known to be a matter of no slight difficulty, and this is an adverse factor to be reckoned with in the case of the improved grate of the future, which will probably require a certain amount of attention. In the case of boiler firemen, however, the outlook is more promising, as the bill recently introduced into Parliament seeking power to grant certificates to qualified men should serve to raise the standard of firemen generally. Although, no doubt, serious opposition will be encountered, I fail to see how anything but good can come of the bill, provided it does not seek to make stoking a "close profession."

In conclusion, I would express the opinion that, although no such startling antithesis as the total prevention of all smoke is to be expected in a manufacturing country like ours, yet as soon as defaulters are assured of a means, they will strive to attain the end so earnestly desired by sanitarians generally.

[*This discussion applies to papers by* Dr. T. L. BAILEY, Dr. C. A. KOHN, *and* Mr. H. L. TERRY.]

The PRESIDENT of the Section (Dr. T. Stevenson) said he need hardly point out to them the importance of detecting and estimating the impurities produced in the air of towns by smoke and other abnormal constituents of the atmosphere. It was plain that in order to assess the value and benefit to be derived from these precise determinations the experiments should be performed in different parts of a city, and it was also very desirable that those of many towns and cities should be collated and compared. That had not been done yet. The whole work was at present voluntary. The work was being done voluntarily at Manchester, Liverpool, and London, and this winter a very small beginning would be made in Leeds. Something was done at Glasgow a few years ago. Nowhere else had there been systematic experiments with the precise appliances that were now available, but he hoped that would no longer be the case.

Mr. A. E. **Fletcher** (London) said he was very glad to add his meed of thanks to the readers of the papers. In reference to sanitary advance the subjects were the most interesting that could be brought before them. He himself at St. Helens and Widnes had used vessels to arrest all acid matters in the air, so that he could compare the relative amount and say whether the acid predominating was sulphuric or hydrochloric. He was able from time to time to say what were the proportions of the two acids. Such figures were given in one of the earlier reports under the Alkali Act, by which a comparison might be drawn between the more chlorous atmosphere of St. Helens, and that of Manchester which was more sulphurous. Other methods had been adopted, but the one brought before them was a more accurate and refined system. He hoped the word smoke prevention would always be used and not smoke combustion. It was absurd to talk about burning smoke, it should be prevented by an efficient air supply. It was not only the waste of fuel in the smoke that they had to deplore—in fact under certain conditions there might be no practical waste of fuel—but the injury to the air, not from carbonic oxide, but from the dirt it brought and the obscuring of the sunlight. He thought these two items were very large. He himself was supposed to have a certain control over noxious gases, and each day people poured into him complaints as to smoke nuisances. That week he had two separate complaints; one of them from Winsford was accompanied by two photographs. The occupant of a house said that new works were started near there, and asked if he could do anything to save them from the dreadful smoke in which they were involved. The two photographs sent certainly spoke volumes for the truth of the complaint. It was sad to hear complaints and to know the cure was within their grasp. If sufficient care and trouble were used they could stop the smoke from boiler fires. According to law, smoke from boilers was prohibited, but the law was in the hands of local people and not put in force. Inspectors appointed by the Local Government Board would be independent of local influence. Their duty would be to enforce the regulations, but they could also point out the practical means for the prevention of black smoke to those whose ignorance was not wilful. They would have a busy time to begin with. While the Act was pending, one-third of the fires would be put in order; the next six months one-third more would be put right. He dared say the last one-third would take a good deal of contrivance, but it would be done, and everybody would afterwards rejoice. He was going to be superannuated, but he hoped that somebody else would take up the matter. It required a young man with plenty of energy and resource, and it must be a case of *suaviter in modo, fortiter in re.* He proposed a vote of thanks to the authors of the papers.

Dr. **Bailey** (Liverpool) said the real point of efficiency was gained when smoke was prevented. He did not know how far the experiments of Scheurer Kestner would go in the direction of completely abolishing smoke.

The **President** of the Section (Dr. T. Stevenson) said the importance of the subject could not be over-estimated. They heard a great deal about bacilli and zymotic disease, but he ventured to say that the unhealthiness and discomfort produced by foul air were as great and as important, if not as vital, as those produced by the numerous bacilli now being discovered.

Dr. C. A. **Kohn** (Liverpool) replied. He said this was only the beginning of their work, and they had brought it up because they thought it would be interesting to the Sanitary Congress. They only hoped that the next time the Congress came to Liverpool they would be able to show more results, and trace some relation, if any was to be traced, between mortality and sickness and the climatological effects of smoke.

Mr. H. L. **Terry** (Manchester), in reply, said that if he judged aright Mr. Fletcher fell in with his suggestion, that it would be well if inspection under the Public Health Act was carried out by independent men, who would report to and advise the local authority. It was easy to see how abuses could arise when a Board, whose members were engaged in industry, appointed the inspector for the district.

On "The Application of the Simultaneous Method of observing Chimneys in Bolton and Oldham," by HERBERT FLETCHER.

At the Congress held by The Sanitary Institute at Bolton in 1887, a resolution was adopted in this Section "That the Council be requested to institute an examination into the best methods of consuming smoke, and to issue the results of their enquiries."

Two years later "The National Committee for testing smoke preventing appliances," was formed in Manchester.

In observing and timing the emissions of smoke from the boiler furnaces under test, a method was followed, which was found to be capable of application to many chimneys simultaneously, and to constitute a good smoke test on a large scale. Its novelty and usefulness may make it interesting to the Congress.

The exhibited record of an hour's observations—made by an observer and his assistant—shows a page of foolscap, with a line for each two minutes, and a column for each chimney. The figures 3, 2, 1 refer to the photographs of three shades of smoke, and show with which of them the observer judged the emission of smoke to best correspond at the minute corresponding with the line on which the figure stands. The dots signify "clear." In order to express the whole of each chimney's smoke by a single figure, values are assigned to the Nos. 2 and 1 shades of one-quarter and one-sixteenth respectively. These photographs were selected as standards, as appearing to bear this relationship to each other. The final figure expresses the character of the chimney in terms of No. 3.

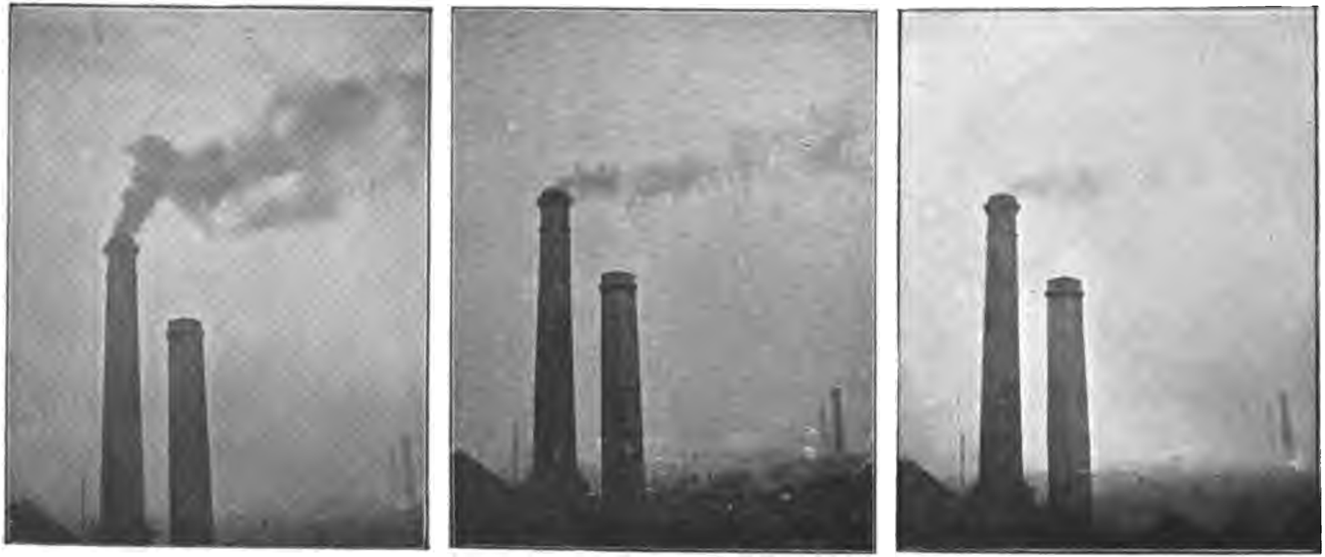
The photographs probably correspond with the terms: Dense or Thick, Medium or Moderate, and Faint or Light, of frequent use, but the use of these terms is to be deprecated, as there is an impression in many places, that smoke must be dense to be illegal; whereas the word in the Public Health Act is "Black," and it would not be denied, that soot—of which all shades of smoke consist—will blacken anything it touches. The gases in which it floats are colourless and invisible and are never alluded to as smoke.

Some chimneys emit much of No. 2 and little of No. 3, and *vice versâ*, and unless a time standard of each kind were fixed by the authority, the prosecution of No. 3, or thick smoke only, would unfairly encourage an appliance, which might send as much soot into the air, as the one complained of, but in more continuous, although thinner, streams.

The figures 1, 4, 16 had their origin in the fixing by the Bolton Corporation of 2½ minutes per half hour of "dense," or 10 minutes of medium, as the temporary allowance intended to remain in force—as stated on the instructions issued to the inspectors, and circulated among the steam users—until the nuisance had been abated to that extent throughout the town.

Thirty chimneys may be observed at once—a round taking 30 seconds, when there is no hesitation on the part of the observer, who calls the number, and no obstruction of view.

Fifteen chimneys may be as easily observed every half minute, Photographs of Three Shades of Smoke used as Standards of Observations.



3. 2. 1.

or seven every quarter, as thirty every minute, but the result will be the same, the parts of a minute in excess of the number recorded balancing the deficiencies in the multitude of observations.

The Lancashire County Council, during August last, addressed a circular to the Local Authorities of the County calling attention to the report of the County Medical Officer on their neglect to enforce the smoke provisions of the Public Health Act, and this step the Council were recommended by the Public Health Committee to take, as an act of courtesy preceding a complaint to the Local Government Board under Sec. 199, with a view to obtaining the appointment by the Local Government Board of a commissioner empowered to perform the duty of the defaulting authorities in the matter of smoke nuisance, and at the expense of such authorities, as provided for by the section. If this would lead to action, this wholesale system of taking observations should be useful to all concerned.

Photography might be employed in confirmation of these observations, a circle of chimneys being observed every minute by several kodaks, or parts of such circle, or a group by one kodak. Photography was employed by Dr. Patterson in his prosecutions for smoke in Oldham, of which he instituted more than 250; by Mrs. Hopwood at Middleton and Heywood, by Dr. March in Rochdale, and by Mr. Bingham and the Smoke Abatement Committee in Sheffield. The complaint to the Local Government Board by the County Council was the suggestion of Dr. Patterson, and was moved by him at his last attendance before his death in the present summer.

No man ever devoted better directed efforts to the cause of air purification than the gallant doctor. Not allowed by his Local Board in his capacity as Medical Officer of Health to move the law—he fought as a private individual.

His method was perhaps more gallant than that of the writer, and he seems to have given less offence. The writer has aimed at moving the local authorities to action, and has depended for a backing, on public opinion, which he has sought to inform and stimulate. The Doctor's method was quicker, but the writer's may be more permanently effective.

It is sometimes supposed, that photographs can be manipulated to increase the degrees of darkness at pleasure, and are therefore not good evidence; but it was shown in court, in Dr. Patterson's cases, that the longer the exposure the fainter appeared the smoke, it being on the move. It is not necessary that the smoke should appear black in the photograph: it should be compared with the shade of the chimney and of other objects—they all pale with distance—but the *volume* of a cloud of smoke is manifest from afar and constitutes good evidence, however pale both it and the chimney may be, for equally pale at a distance means equally dark when near.

By the use during the summer of 1894 for nine days of the described system of observing a number of chimneys at the same time, once every minute, throughout the whole day, it has been possible to record the duration and density of the emissions of smoke from 215 of the larger chimneys.

Of these 215, after deducting those which were not available for purposes of comparison, there remained 95 in Bolton and 65 in Oldham. In these two towns during the last six or seven years, the provisions of the Public Health Act against the nuisance—Section 91—have been more strenuously enforced by public and private prosecutions than in any others in the country, and they are able now to show a greater number and a greater variety of appliances for its prevention, than are to be found in other towns.

The observations were made unknown to the firms or their firemen, with nine exceptions. Of these nine, seven were warned, and two found out, that they were under observation. Their figures appear among the larger in the list, being 19, 23, 19, 14, 13, 9, 15, 11, 9. They were all hand-fired. It was at the time intended to repeat the observations after warning all, in order to ascertain the effect of pains-taking, but twice the attempt was foiled by mist or rain, and it has not been done.

After all, it is more important to know the *usual* conditions, than what a stimulant can make them.

To judge of the merits of appliances a knowledge of the rate of consumption and of the draught are essential, and also their independence of constant attention, but from the averages obtained, a fairly correct idea may be formed of the degree to which the smoke nuisance may be reduced by well-tried means.

The observations show that the manufacturing smoke nuisance in these two towns arises from an average emission—when expressed in terms of No. 3 or thick smoke—of ten minutes in each of the ten working hours of the working day. Of these ten minutes only six are "thick," three are "medium," and one is "faint," but the "medium" and "faint" are here expressed in terms of "thick," and their numbers *three* and *one* represent *twelve* and *sixteen* minutes of their respective shades.

Machines, Cokers.

At 73 chimneys, nearly one-half the number, machines for stoking were found to be in use. Of these there were 23 where the boilers had machines of the kind known as "cokers," 19 having those which use an igniting brick arch with downward ignition, and 4 having those which use no arch with upward ignition.

The average smoke was respectively, with arch 1·7 minutes, the rate of firing being 19½ tons, and without arch 3·9 minutes, the rate being also 19½ tons. The worst example of the "cokers" made 3·5 minutes—a recent installation—with two 7½-feet boilers, burning 26 tons each per week of 60 hours with a poor draught. The best cotton-mill-example of the "cokers" made 0·6 minutes as the average of four whole days' observation, with three 8-feet boilers, burning 24 tons each, and a good draught; but a corn mill running day and night with one boiler 7½ feet, burning 35 tons in 125 hours, made only 0·2.

Machines, Sprinklers.

At 34 chimneys the boilers had "sprinklers," those at 14 having self-cleaning, and those at 20 having stationary bars; average smoke—with self-cleaning bars 9·5 minutes, the rate of firing being 22 tons—and with stationary bars 11·5 minutes, the rate being 17¾ tons.

The worst example of the "sprinklers" made 24·6 minutes with four boilers, 7½ feet diameter, 73 tons, and medium draught. The best "sprinkling" example made 1·4 minutes, with one 7½-feet boiler and good draught, burning 22 tons a week of superior, or nut, slack (so clean that the fires had not to be cleaned out during the whole day's observation); fixed bars, not self-cleaning in both these cases.

At 15 chimneys the boilers were variously fired, more than one system being in use.

Hand-firing, Doors ajar.

The appliances for preventing smoke in hand-firing vary the admission of air according to the admission of fuel; whereas machines, by making the introduction of fuel continuous, require nothing to vary the constant and uniform draught of a chimney. The most successful of these appeared to be the firemen themselves, whose only resource, in the nine instances observed, was to leave the fire-doors ajar for two or three minutes after firing.

In these nine instances, with good draught, and an average rate of firing of 15½ tons per 7-feet boiler in 60 hours, the smoke averaged 4·3 minutes. The extremes of bad and good were —"bad"—8·3 minutes with two boilers, a rate of 12½ tons and a good draught; and—"good"—3·3 minutes with three boilers, a rate of 18 tons and also a good draught. Whether the difference would be accounted for by the difference in the time the doors were left ajar, was not investigated.

Hand-firing *with* Appliances.

In 38 instances air was found to be admitted by appliances attached to ordinary hand-fired boilers, 14 admitting the air at the front of the fire, 10 at the back, and 14 at both front and back. Their respective averages were 12, 9, and 7, and the average of the 38 was 9. The worst example among the mills—a colliery being worse still—was in those of front admission, namely, by steam-jets above the fire—27·7 minutes with four boilers 8 feet diameter, 84 tons—rate 18—and good draught. In the best example air was let in at front and back by self-acting air-grids in the fire-doors and by hollow bars—2·9 minutes with two boilers 7 feet, 40 tons—rate 20—and good draught. In this case the horse-power developed per ton-burnt-per-week was only 8·5, whereas in the former case it was 14·5 (according to information given), pointing to some cause of great loss in boilers or engines.

Hand-firing *without* Methods or Appliances.

In only 41 cases (25 per cent. of the whole number) was simple hand-firing practised without any appliances or special methods for preventing smoke. Their average of smoke was 15·3 minutes, the rate of firing being 16 tons per week of 60 hours per 7-feet boiler. The worst showed 38·8 minutes, with four 7½ and two 8½-feet boilers, burning 165 tons, or at the rate of 24 tons per 7-feet boiler; the two 8½-feet boilers having a fair, and the four a poor, draught. The best showed only 3·9, with three 7-feet boilers, 33 tons—rate 11—and a good draught.

Draught.

The power developed, as measured by the rate of consumption and evaporation, depends chiefly on the draught of air through the bars of the furnaces, and these developments of power cannot be compared with one another, where the draughts differ. The water gauge, or bent glass tube with water, applied to the base of the chimney is a good indication, but the proper place for the end of the iron tube connected with the gauge is the furnace flue midway—of, and above, the fire. For ordinary Lancashire boilers, where the draught is not materially impeded by tubes or dust, the back end of this flue is the usual and proper place.

It will be seen from the foregoing that the suppression of smoke in boiler fires is being reduced from an average of 15·3 for 43 instances of ordinary hand-firing without appliances or special methods, to an average of 1·7 for 19 instances, and it may be inferred, that if the same care is taken as in the best example this average may be still further reduced to 0·6. The information is being collected, and the tests of evaporation have been made, in order to show if this reduction involves a sacrifice of either power or economy.

A table of results of the observations classifying the appliances, and giving particulars of the work done, with names of firms owning the chimneys and of the makers of the appliances, will form part of the report of the National Committee for Testing Smoke Preventing Appliances—Secretary, Mr. Fred. Scott, 33, Brazennose Street, Manchester.

Mr. H. L. **Terry** (Manchester) said it seemed to him that this application of photography must prove of considerable value as evidence in smoke prosecutions, as the prints would serve to corroborate the bare statements of the inspector. The "personal equation" was an important element in such observations, and it was desirable to eliminate it as far as possible.

Mr. **Herbert Fletcher** (Bolton) said, only as a means for checking observations. If the observation was disputed the photograph would be a corroboration. It would be desirable to have some mechanical means for supporting observations. Such a use of photography should be of great interest to any local authorities who took up the smoke nuisance question.

Mr. **Knox** (Liverpool) said the difficulty appeared to be the disputing of the truthfulness of the inspector in his observations.

Mr. **Herbert Fletcher** (Bolton) said most people would think that photographs could best establish the evidence of the inspector. In three cases heard at Rochdale last week the Solicitor for the defence objected to photographs as not being of a nature that could be refuted if required, and nothing could be done with them in the way of cross-examination; also that if photographs were admitted they should be the work of a person whose ability, correctness, and impartiality could be relied upon. Well, he (Mr. Fletcher) thought that nothing could be more impartial than a photograph. The negative should be produced in court by the person who took it. Sometimes cases seemed to be dismissed on negative evidence—people coming forward to say they had lived in the neighbourhood and had experienced no nuisance. He believed the most advanced town in the country in the application of both law and machinery in the suppression of the nuisance was Bolton.

Mr. **Knox** (Liverpool) said that in some courts the whole point turned on the word "dense."

Mr. **Herbert Fletcher** (Bolton) said it was sometimes supposed that only "dense" smoke was illegal, whereas all smoke was "black," and the Public Health Act did not say anything about "dense." In some places they had to educate the Bench. Some magistrates would not admit that smoke was a nuisance. The way was to go on prosecuting without caring for defeat. Frequent dismissals of cases brought before the magistrates by the authorities specially entrusted by law with the duty of suppressing nuisances would produce a scandal and an outcry, which would not be disregarded by the most unsympathetic bench, nor does the same bench sit continuously. An authority that is really in earnest, and which represents public opinion, will have no cause for complaint after the first few dismissals by a Bench uncertain as to which way the wind blows.

The President of the Section (Dr. T. Stevenson) said that if it was true the safest and best way to get anything done was to agitate, then he thought that Mr. Fletcher had commenced to purify the smoky atmosphere of Lancashire, and they would be ready to accord him thanks for his interesting details. The principle which seemed to be established by Mr. Fletcher was, that where anybody persistently made a nuisance, the inspector should be a greater nuisance to him.

REVIEWS OF BOOKS.

"A TREATISE ON HYGIENE AND PUBLIC HEALTH."*

This volume on Sanitary Law concludes the task of the able editors of the largest and most comprehensive work on hygiene in the English tongue. The authors are stated to be "gentlemen of recognised legal ability, each of whom is officially engaged in the administration of the law of that part of the United Kingdom to which his article relates," which we presume means that at least the three divisions—English, Scotch, Irish,—have been compiled by three different individuals.

For at least twenty years each Parliamentary session has produced a crop of Sanitary Bills, a great number of which have become law: the resulting legislation is voluminous, discontinuous, hesitating, imperfect; in some cases unwisely permissive, in others imprudently compulsory, but with all its defects of omission and commission, our health legislation (in comparison with that of other countries) stands unrivalled as an exposition of the practical application of accepted principles.

For collecting the scattered materials and presenting them in a convenient form under definite heads, the authors of this work on Sanitary Law deserve the gratitude of members of local authorities and of Medical Officers of Health generally; the arrangement of the work is praiseworthy; for the first time the essential parts of the whole of the Sanitary Law have been collated, so that they may be systematically studied in one volume of no great size.

Law consists of text and commentary; the text being the statutes themselves, the commentary, the opinions of persons versed in legal principles, and particularly of the judgments delivered from time to time in the Higher Courts of Law. The point most open to adverse criticism, is the scantiness of the commentary; the work is confessedly written for the use of persons who have not received a legal education, and for such surely the most essential thing is a clear, definite, elucidation of the meaning of terms employed, especially in those cases where the meaning is somewhat different to that ascribed in common speech. As examples, take the distinction between "drain" and "sewer" given in a cursory and incomplete manner; take again the word "diseased" in the Dairies, Cowsheds, and Milkshops' Order (p. 146), the meaning of which has not been given in the text, and will naturally be interpreted by the ordinary reader in the widest sense, whereas "disease," in the principal Act under which the Order has been made, is restricted to certain maladies only.

The authors had an excellent opportunity of imparting useful information of which they have not availed themselves. We all want to know what distance from houses in the country the Local Government Board consider "reasonable" for the purposes of water supply, but on this they are silent.

---

* Edited by Thomas Stevenson, M.D., F.R.C.P., and Shirley F. Murphy, Medical Officer of Health of the administrative County of London. Vol. III., "Sanitary Law." Large 8vo., 459 pp.

In some cases admiration is expressed of enactments which continue to receive the hearty and unqualified condemnation of Medical Officers of Health, as for instance Section 4 of the Diseases Prevention Act; we are told that this Section is very valuable, and that "if properly and wisely exercised it may greatly facilitate the investigation of the origin of epidemics where an outbreak of disease is suspected to originate in the milk supplied from any particular farm, cowshed, or milk shop." It may be true that the formalities of the section which practically prevent the arrest of the distribution of an infected milk supply for a period varying from several days to several weeks, may aid in the investigation of origin because it will increase the number of deaths and attacks and thus accumulate evidence, but as it will not crush out the epidemic, which can only be arrested by the most prompt action on the part of the officers of a local authority, the praise given shows a curious misapprehension of the effect of the section. Fortunately the section of the Act is permissive, and a local authority may adopt it or not, as it pleases; it is to be hoped that common sense will allow it to remain inoperative.

There are many other points on which the reviewer is either at variance with the authors, or which he considers are open to criticism, but these are slight matters of detail which by no means alter his favourable opinion of the work as a whole. It is clearly printed on good paper, the index is excellent, and considering the mass of information, the price is not unreasonable; those who have neither time nor inclination to study the Sanitary Law, will yet find the book invaluable for the purposes of reference.

A. WYNTER BLYTH.

NOTES ON LEGISLATION AND LAW CASES.

Prepared by Prof. A. Wynter Blyth.

Before JUSTICES MATHEW and CHARLES.

PILBROW *v.* VESTRY OF ST. LEONARD, SHOREDITCH.

(*Times*, Nov. 3rd, 1894.)

Definition of "drain" under the Public Health and Metropolis Local Management Acts. Sets of Artisans' Dwellings consisting of two blocks of forty-six sets of apartments drained into a common drain by twelve branch drains. Held that the "common drain" was a drain and not a sewer, and that the premises were within one curtilage.

This was a special case stated by a Metropolitan Magistrate.

In August, 1892, the appellant Pilbrow appeared to a summons, issued by the Vestry of St. Leonard, Shoreditch, to recover expenses to the amount of £209. 7s. 6d. incurred by the Vestry as sanitary authority in amending, &c., the drains at Norfolk Buildings, of which the appellant was the owner. These buildings consisted of forty-six sets of apartments divided into two blocks, separated by a causeway 20 ft. wide. They were erected and the drains put in by the owner in 1882 without any plans having been submitted to the local authority, or any sanction or inspection by them. The drainage was by means of twelve branch drains running into a main drain under the causeway, which ran into a sewer within 100 ft. of the blocks. The branch drains were inserted into the main drain through holes cut in the pipe. On Nov. 18th, 1891, the Inspector of Nuisances gave notice to the owner to amend and reconstruct the main drains, and provide a properly-ventilated inspection chamber, and to amend the branch drains, to disconnect certain waste pipes, &c. The requisition was not complied with, and the works were ultimately done by the Vestry at the cost demanded. The appellant contended that no order could be made against him because the alleged main drain was used "for the drainage of more than one building," and not "for draining any block of houses by a combined operation under the order of any Vestry or District Board," and was therefore not a "drain" but a "sewer" within the meaning of the interpretation clause (250) of the Metropolis Local Management Act, 1855 (18 and 19 Victoria, c. 120). The Magistrate held that the alleged main drain in question draining blocks of houses by a combined operation was, under the circumstances, and notwithstanding the absence of any order of the Vestry for the purpose, a "drain" and not a "sewer" within the meaning of the Acts, and made an order on the appellant to pay the amount charged.

Mr. R. Woodfin (Mr. Poland, Q.C., with him) appeared on behalf of the appellant; Mr. Finlay, Q.C., and Mr. Lewis Thomas appeared for the Vestry.

Mr. **Woodfin** cited the cases of "Bateman *v.* Poplar Board of Works" (2 *The Times* L. R., 637, 33 Ch.D., 360) and "Travis *v.* Uttley" (1894) (1 Q.B.). He urged that the two blocks were not in the same curtilage, and that, therefore, at any rate the main drain was a "sewer" for which the Vestry was responsible and not the owner.

Mr. **Finlay** said it would be most inequitable if a man could put up houses and make drains without leave or inspection of the authority, and then throw them on the Vestry. These blocks were in one curtilage, and, therefore, the drain came within the following words of 18 and 19 Vic., c. 120, Section 250:—"In the construction of this Act 'drain' shall mean and include any drain of and used for the drainage of one building only or premises within the same curtilage, and made merely for the purpose of communicating with a cesspool or other receptacle for drainage of two or more buildings."

The **Court** upheld the decision of the Magistrate.

Mr. **Justice Mathew** said the question was whether this drain was a "drain" or a "sewer" within the meaning of Section 250. Here there were two blocks with a causeway lying between them which was occupied by the common dustbin. The courtyard or causeway must be considered as within the curtilage of both blocks. The definitions in the books supported this view. He then cited "Stroud's Judicial Dictionary" and "Jacobs's Law Dictionary," and referred to the cases of "Marson *v.* London, Chatham, and Dover Railway" (L.R. 6, Eq., 101), and "Commissioners of Inland Revenue *v.* Goodfellow" (45 J.P.). This drain therefore came within the very definition given in the statute.

Mr. JUSTICE CHARLES concurred. It had been suggested that there was something in the definition of the word "street" which prohibited the Court from holding that this causeway was within the curtilage. He could not adopt that view. The appeal must be dismissed with costs.

QUEEN'S BENCH DIVISION.

Before JUSTICES MATHEW and KENNEDY.

THE VESTRY OF THE PARISH OF ST. MARTIN-IN-THE-FIELDS *v.* BIRD.

(71 *L. T.* Rep., 432.)

An Arcade consisting of houses and shops separately rated and occupied, and arched over with a common roof, the Arcade enclosed by gates shut every evening, is not one building nor "premises within the same curtilage," within the meaning of Section 250 *of the Metropolis Management Act (*18 *and* 19 *Vict. c.* 120*), and therefore if the said houses or shops drain into a common drain such drain is a sewer.*

This was a case stated in order to determine whether the Vestry was liable to put the drains in order of the Lowther Arcade in the Strand.

Mr. BEVEN argued for the plaintiffs that the Lowther Arcade is one building, because it is arched over by a common roof and shut in by common gates, the property of one person and used for one purpose as a bazaar. If it is not one "building" it is within the definition of "premises within the same curtilage." The word "premises" is a much wider term than "building," and has been defined by Turner, *L. J.*, in the case of "Lethbridge *v.* Lethbridge" (6 *L. T.* Rep. 727): "The word 'premises' as used in this clause must I think be taken to mean premises in immediate connection with the mansion, and without the occupation of which the mansion could not be conveniently occupied and enjoyed." In the case of "Read *v.* Read" (*W. N.*, 1866, p. 386) the Master of the Rolls says:—"The word 'premises' is as nearly as possible synonymous with 'appurtenances.'" In "Shepherd's Touchstone" it is said that a grant of messuage with the appurtenances passes the "curtilage." The word "curtilage" has been defined in the case of "Marson *v.* The London, Chatham, and Dover Railway Co." (18 *L. T.* Rep. 317, L. Rep. 6, Eq. 101). In the present case the use to which the passage has been put brings it within such a definition. The drainage here is the private property of the owner, it runs under the passage which he keeps within his own hands and shuts off from the public; those who pass along it only do so by the owner's license.

Mr. MACMORRAN (for the defendant): When a drain receives the drainage of two or more houses it is *prima facie* a sewer without regard to whether it is constructed by a local authority or by a private person. "Travis *v.* Uttley" (70 *L. T.* Rep. 242, 1894) where the Court held that a drain passing under and receiving the drainage of three houses was a sewer. In the present case this drain is a sewer within the meaning of the Act. In this Arcade there are twenty-five houses let to eighteen different occupiers, some of whom live on the premises. Each of these houses is distinct and separate, and has a curtilage of its own. The fact of the Arcade being the property of a common owner is only an accident and does not affect the question. These are distinct houses and shops, separately occupied and separately rated, and they are separately drained into a common drain. It is submitted that they are not within the same curtilage within the meaning of the Act.

Mr. Justice Mathew: I think that the drainage mentioned here is vested under the Metropolis Management Act in the local authority, and that the owner cannot therefore be called upon to repair. This is a sewer unless it be a drain, and it is not a drain within the meaning of the Act, unless it be "used for the drainage of one building only or for premises within the same curtilage, and made merely for the purpose of communicating with a cesspool or other like receptacle for drainage, or with a sewer into which the drainage of two or more buildings or premises occupied by different persons is conveyed, and shall also include any drain for draining any group or block of houses drained by a combined operation under the order of any Vestry or District Board." Now, it is admitted here that there was no order of any Vestry or District Board, and the question is whether this is a drain within the definition of Section 250 of the Metropolis Local Management Act. I cannot bring myself to think that this is anything but a row of shops which happens to be occupied in a peculiar way, namely, with entrance gates at each end for the purpose of securing privacy and safety. But that does not prevent the tenements within the gates at each end being separate tenements, as they unquestionably are, and they are separately assessed as such. Then does it cease to be a row of houses on each side because there is a covering to the passage through the Arcade? I cannot see why it should. The covering inside is convenient no doubt for those who have to repair to the shops in the Arcade. Take the case of Chester. There the shops are under an Arcade. But can anyone say they are not separate shops? The shelter afforded by the roof cannot make any difference. Then are they "premises within the same curtilage?" That is the other description. Each of these tenements stands by itself, is accepted as a dwelling house, is used as such, and has its own curtilage. It would be an extravagant and extraordinary use of the term "curtilage" to hold because there are gates at each end and a covering that there is one curtilage to the whole of this area. I am of opinion, therefore, that the owner is exempt from this liability and that it falls on the Vestry.

Mr. Justice Kennedy: I entirely agree.

Judgment for the defendant.

QUEEN'S BENCH DIVISION,

Before JUSTICES MATHEW AND CHARLES.

SAUNDERS *v.* THE HOLBORN DISTRICT BOARD OF WORKS.

(*L. T.* Rep., Vol. 71, 519.)

A penalty is provided by the London Public Health Act for non-performance of certain statutory duties as to cleansing the streets, and it was held that an action for special damage to an individual was not maintainable.

On the 8th January, 1894, the plaintiff slipped on some frozen snow lying on the pavement, and she alleged she had suffered special damage, spraining in fact her wrist, and that the sprain interfered with her duties as a nurse. She brought an action in the County Court, but the County Court Judge gave as his opinion that the intention of the legislature was that the penalty imposed by the Act should be the only remedy for the failure of the sanitary authority to perform their statutory duty, and nonsuited the plaintiff. The plaintiff appealed.

The case is sufficiently explained by the judgment.

Mr. JUSTICE MATHEW: I am of opinion that this appeal should be dismissed. The action was brought to recover damages for injuries alleged to have been sustained by the plaintiff through the failure of the defendants to discharge their statutory duty of removing snow and ice from the footways over which the plaintiff was passing. It was said that under the Act of 1891 the duty which had been previously imposed upon each householder to clear away the snow and ice in front of the house had been imposed upon the defendants, and that therefore they were liable. Now the terms of the Section are these (His Lordship read Section 29 P. H. (Lond.) Act, 1891). Those are the obligations created by the statute in this public body, and it is said upon the authority of "Couch *v.* Steel" (3 E. & B. 402), and "Hartnell *v.* the Ryde Commissioners" (8 *L. T.* Rep. 74), which are still treated by the learned counsel for the plaintiff as having some vitality in them, that his client is entitled to maintain this action. Relying upon these cases, little credit is given by him to the subsequent decisions beginning with the well-known case of "Atkinson *v.* Newcastle and Gateshead Water Company" (36 *L. T.* Rep. 76). That case has been followed by the case in the House of Lords of "Cowley *v.* the Newmarket Board" (67 *L. T.* Rep. 486), and by the more recent decision of the Judicial Committee of the Privy Council in the municipality of "Pictou *v.* Geldert" (69 *L. T.* Rep. 510). Those cases condemn in terms the cases of "Couch *v.* Steel" and "Hartnell *v.* the Ryde Commissioners." It is quite plain that the result of those decisions with reference to the obligations imposed upon bodies of this kind by Act of Parliament, is that unless the intention of the legislature is clearly expressed, that there shall be a liability to an action for default in the performance of a statutory duty no action shall lie. Upon looking at this statute it is clear there is no intention that any such liability shall be imposed on the defendants. I have read the Section, and in case of non-performance of the duties created by the Section, there is imposed a penalty not to exceed £20, to be recovered in the manner pointed out by the Act. That is the sole liability imposed by the statute upon the defendants, and why should we infer that there is in addition a liability to an action for damages. By the old statute before it was repealed there was no liability upon the local authority to clear away snow or ice, and no such action would lie against the inhabitants of the district in reference to such a matter. Why, then, should it be said that this statute creates the liability? It seems to me that the intention of the legislature must have effect given to it according to the language used, namely, that the local authority shall be bound to do what the statute says it is bound to do, and that the consequence of not doing it shall be the liability pointed out by the Act, and no further liability. If we adopted any other construction we should be putting upon the locality an obligation which does not exist at common law, and for which there is no statutory provision.

Mr. JUSTICE CHARLES concurred. Appeal dismissed.

MEETINGS HELD OCTOBER TO DECEMBER, 1894.

SESSIONAL MEETINGS.

A Meeting was held on December 12th, at 8 p.m., when a discussion was opened by George Blundell Longstaff, M.A., M.D., F.R.C.P., on "The Sanitary Aspects of the London Building Act, 1894." About 200 Members, Associates, and Visitors attended this meeting. The discussion will be published in Part I., Vol. XVI.

LECTURES AND DEMONSTRATIONS TO SANITARY OFFICERS, LONDON.

The Eighteenth Course consisting of 21 Lectures and 13 Practical Demonstrations and visits of inspection to trade premises, Refuse Disposal Works, commenced on October 17th and ended on December 3rd. A list of these is given in Part III., Vol. XV. 112 Students entered their names for this course.

LIVERPOOL.

A course of 12 Lectures were given in conjunction with the Technical Instruction Committee of the Corporation of Liverpool, commencing September 29th and ended December 15th. 100 Students entered their names for this course. In connection with these Lectures arrangements were made for inspection and demonstrations for the students at the following places and works:—

Lodging Houses.
Disinfecting Stations.
Cellar Dwellings.
Lairages.
Infectious Hospitals.
Baths.
Wash-houses.
Mortuary.
Princes Dock.
Artizans and Labourers' Dwellings.
Crematorium.

A Special Demonstation was arranged at the Exhibition of the Institute, which was being held at Liverpool, by Mr. H. Percy Boulnois, M.Inst.C.E., the City Engineer.

SANITATION OF INDUSTRIES AND OCCUPATIONS.

The second course of free Lectures was given during November. There was an average attendance of 45 at each Lecture.

EXAMINATIONS.

An adjourned examination for Local Surveyors, completing the one held in June, was held in London on November 16th and 17th. 12 Candidates presented themselves; 9 Candidates were certified to be competent as regards their sanitary knowledge to discharge the duties of Local Surveyors.

Examinations for Inspectors of Nuisances were held in the following towns:—

London, December 7th and 8th. 112 candidates presented themselves; 68 were certified to be competent as regards their sanitary knowledge to discharge the duties of Inspectors of Nuisances.

Cardiff, December 14th and 15th. 18 candidates presented themselves, 9 were certified. The Medical Officer of the Glamorgan County Council and the Medical Officer of Health, Cardiff, attended as visitors.

Liverpool, Dec. 21st and 22nd. 67 Candidates presented themselves; 30 were certified.

CALENDAR, JANUARY TO APRIL, 1895.

JANUARY.

7 M. Exhibition Committee, 5 p.m.
9 W. Finance Committee, 4 p.m.
9 W. Council Meeting, 5 p.m.
21 M. Education Committee, 5 p.m.
28 M. Museum Committee, 5 p.m.

FEBRUARY.

1 F. Lecture to Sanitary Officers, London, 8 p.m. Chemical Physics I. (Mechanical Physics), by J. Castell-Evans, F.I.C.
4 M. Exhibition Committee, 5 p.m.
5 T. Lecture to Sanitary Officers, London, 8 p.m. Chemical Physics II. (Natural Forces), by J. Castell-Evans, F.I.C.
8 F. Lecture to Sanitary Officers, London, 8 p.m. Chemical Physics III. (The Atmosphere), by J. Castell-Evans, F.I.C.
12 T. Lecture to Sanitary Officers, London, 8 p.m. Elementary Bacteriology, by R. T. Hewlett, M.D., M.R.C.S.
13 W. Finance Committee, 4 p.m.
13 W. Council Meeting, 5 p.m.
13 W. Sessional Meeting, 8 p.m. Discussion on "Dry Methods of Sanitation," opened by G. V. Poore, M.D., F.R.C.P.
15 F. Lecture to Sanitary Officers, London, 8 p.m. Chemical Physics IV. (Water), by J. Castell-Evans, F.I.C.
15 F. }
16 S. } Examination for Inspectors, Bristol.

18 M. Education Committee, 5 p.m.

19 T. Lecture to Sanitary Officers, London, 8 p.m. Chemical Physics V. (The Chemistry of Fuel and Combustion), by J. Castell-Evans, F.I.C.

22 F. Lecture to Sanitary Officers, London, 8 p.m. Chemical Physics VI. (Sanitary Chemistry), by J. Castell-Evans, F.I.C.

25 M. Museum Committee, 5 p.m.

25 M. Lecture to Sanitary Officers, London, 8 p.m. Ventilation, Warming and Lighting, by Sir Douglas Galton, K.C.B., &c.

26 T. Lecture to Sanitary Officers, London, 8 p.m. Sanitary Law; English, Scotch and Irish; by H. Manley, M.A., M.B., D.P.H.

MARCH.

1 F. Lecture to Sanitary Officers, London, 8 p.m. The Law Relating to the Supervision of Food Supply, by A. Wynter Blyth.

4 M. Exhibition Committee, 5 p.m.

5 T. Lecture to Sanitary Officers, London, 8 p.m. Sanitary Laws and Regulations Governing the Metropolis, by A. Wynter Blyth.

6 W. Inspection and Demonstration of Disinfecting Apparatus and Model Steam Laundry at St. John's Wharf, Fulham.

8 F. Lecture to Sanitary Officers, London, 8 p.m. Objects and Methods of Inspection, by J. F. J. Sykes, D.SC., M.D.

9 S. Inspection and Demonstration at Friern Barnet Sewage Works.

12 T. Lecture to Sanitary Officers, London, 8 p.m. Nature of Nuisances including Nuisances, the abate-of which is difficult, by Arthur Newsholme, M.D., D.P.H.

13 W. Inspection and Demonstration, St. Pancras Disinfecting Station, 3 p.m.

13 W. Finance Committee, 4 p.m.

13 W. Council Meeting, 5 p.m.

13 W. Sessional Meeting, 8 p.m. Discussion on "Back-to-Back Houses," opened by T. de Courcey Meade, M.INST.C.E., and J. Niven, M.D.

15 F. Lecture to Sanitary Officers, London, 8 p.m. Trade Nuisances, by Prof. A. Bostock Hill, M.D.

15 F.} Examination for Inspectors,
16 S.} Newcastle.

16 S. Inspection and Demonstration.

18 M. Education Committee, 5 p.m.

19 T. Lecture to Sanitary Officers, London, 8 p.m. Diseases of Animals in Relation to Meat Supply, &c., by A. Wynter Blyth.

20 W. **Ordinary General Meeting, 4 p.m.**

20 W. Inspection and Demonstration at East London Water Works, Lea Bridge.

22 F. Lecture to Sanitary Officers, London, 8 p.m. Water Supply: Drinking Water; Pollution of Water, by Louis Parkes, M.D., D.P.H.

23 S. Inspection and Demonstration at Beddington Sewage Farm, Croydon.

25 M. Museum Committee, 5 p.m.

26 T. Lecture to Ladies. Domestic Hygiene (Fire), 3 p.m., by A. T. Schofield, M.D.

26 T. Lecture to Sanitary Officers, London, 8 p.m. Infectious Diseases and Methods of Disinfection, by Edward C. Seaton, M.D., F.R.C.P.

27 W. Inspection and Demonstration at St. George's, Hanover Square.

29 F. Lecture to Ladies. Domestic Hygiene (Air), 3 p.m, by A. T. Schofield, M.D.

29 F. Lecture to Sanitary Officers, London, 8 p.m. Principles of Calculating Areas, Cubic Space, &c., by H. Law, M.INST.C.E.

30 S. Inspection and Demonstration at Harrison and Barber's Knacker's Yard, Whitechapel.

APRIL.

2 T. Lecture to Ladies. Domestic Hygiene (Earth), 3 p.m., by A. T. Schofield, M.D.

2 T. Lecture to Sanitary Officers, London, 8 p.m. Sanitary Building Construction, by Prof. T. Roger Smith, F.R.I.B.A.

3 W. Inspection and Demonstration at Chelsea, 3 p.m.

3 W. Sessional Meeting, 8 p.m. Discussion on "Combined Drainage," opened by J. F. J. Sykes, D.SC., M.D.

5 F. Lecture to Ladies. Domestic Hygiene (Water), 3 p.m., by A. T. Schofield, M.D.

5 F. Lecture to Sanitary Officers, London, 8 p.m. Sanitary Appliances, by Professor W. H. Corfield, M.A., M.D.

5 F. } Examination for Inspectors,
6 S. } Southampton.

6 S. Inspection and Demonstration at East Surrey Water Works, Kenley.

9 T. Lecture to Sanitary Officers, London, 8 p.m. Details of Plumber's Work, by J. Wright Clarke.

10 W. Inspection and Demonstration at St. George's, Hanover Square, 2 p.m.

10 W. Finance Committee, 4 p.m.

10 W. Council Meeting, 5 p.m.

HON. FELLOWS, FELLOWS, MEMBERS, AND ASSOCIATES ELECTED.

From October to December, 1894, inclusive.

HONORARY FELLOWS.

Reg. No. Date of Election.

FRANCE.

34 1894. Dec. MASSON, Louis, 6, *Avenue Victoria, Paris. Ingénieur, Inspecteur de l'assainissement de Paris. Chef du Service de l'assainissement des habitations de Paris (since 1881).*

AUSTRIA-HUNGARY.

33 1894. Dec. MULLER, Dr. Koloman, *Rochus Hospital, Budapest, Hungary.*

FELLOW (FELLOW SAN. INST.)

674 1894. Oct. MANLEY, Herbert, M.A., M.B.(CAMB.), D.P.H., M.O.H., *New Street, West Bromwich.*

MEMBERS (MEM. SAN. INST.)

† Passed Examination as Local Surveyor.
‡ Passed Examination as Inspector of Nuisances.

844 1894. Nov. ABLIDGE, John T., M.D., A.B.(LOND.), F.R.C.P.(LOND.), *The High Grove, Stoke-on-Trent.*

84 1894. Nov. †BARNARD, Leonard William, *London Sanitary Protection Association*, 21, *Great George Street, S.W.*

830 1894. Nov. BURNE, Joseph Graham, M.R.C.P., M.O.H., 38, *Westland Row, Dublin.*

Reg. No.	Date of Election.	
813	1894. Nov.	CARDONA, Joseph, Junr., M.S.A., F.S.I., *Grosvenor Street, Gibraltar.*
851	1894. Nov.	†‡DAVIES, Albert John, 154, *Severn Road, Cardiff.*
852	1894. Nov.	DIXON, E. K., M.E., M.INST.C.E., *The Green, Castlebar, County Mayo.*
853	1894. Nov.	DUDFIELD, Reginald Samuel Orme, M.A., M.B., D.P.H., M.O.H., 19, *Blomfield Road, Maida Vale. W.*
854	1894. Nov.	DUNCANSON, Thomas, ASSOC.M.INST.C.E., *Municipal Offices, Liverpool.*
855	1894. Nov.	EAYRS, John T., M.INST.C.E., F.S.I., *Borough Engineer, West Bromwich, Staffs.*
856	1894. Nov.	FIDLER, Alfred, ASSOC.M.INST.C.E., *Water Engineer's Office, Blackburn.*
876	1894. Dec.	FIRTH, Surgeon, Captain Robert Hammill, D.P.H., F.R.C.S., *Maisonette, Woolston, Hants.*
859	1894. Nov.	HANSON, Edward B., M.INST.C.E., *Bedford House, Bedford Street, Plymouth.*
838	1894. Oct.	HAWKINGS, Stanley, *Local Board Offices, Bromley, Kent.*
816	1894. Nov.	†‡HOGBIN, Leonard W., *District Surveyor, Minster, Isle of Thanet.*
860	1894. Nov.	HUNTER, William Lovell, M.D., D.P.H., M.O.H., *Pudsey, Yorkshire.*
861	1894. Nov.	JONES, Herbert, D.P.H., M.O.H., *Municipal Offices, Crewe.*
862	1894. Nov.	JONES, Hugh Richard, M.A., M.D., B.SC., D.P.H. 58A, *Grove Street, Liverpool.*
863	1894. Nov.	JUDSON, Thomas Robert, M.R.C.S., D.P.H., 28, *Mill Lane, West Derby, Lancs.*
839	1894. Oct.	‡KENEALY, Miss Henrietta Maria, *Bushey Grove, Watford, Herts.*
840	1894. Oct.	†LASHMORE, Ernest Ward, 57, *Denzie Avenue, Southampton.*
867	1894. Nov.	†‡LEVERTON, John H., 45, *Lisburne Road, Hampstead, N.W.*
812	1894. Oct.	†‡LYON, James Joseph, 6, *Rice Lane, Walton-on-the-Hill, Liverpool.*
868	1894. Nov.	MARRIOTT, William, M.INST.C.E., M.I.M.E., *Melton Constable, Norfolk.*
869	1894. Nov.	MAXWELL, Francis William, F.S.I., 41, *Corporation Street, Manchester.*
870	1894. Nov.	MOORE, Samson George, M.B., CH.B., ASST.M.O.H., *Port Sanitary Authority, Liverpool.*
877	1894. Dec.	NARIMAN, Sorabji Kharsedji, M.D., B.SC., D.P.H., 19, *Shirland Road, Paddington, W.*
847	1894. Nov.	PATTEN, H. Cooper, M.A., M.B., D.P.H., M.O.H., *Municipal Offices, Norwich.*
871	1864. Nov.	PERMEWAN, Arthur Edward, M.D., J.P., D.P.H., M.O.H., *Belmont, Redruth, Cornwall.*

Reg. No.	Date of Election.	
878	1894. Dec.	**Price**, John, ASSOC.M.INST.C.E., *Local Board Offices, Lark Lane, Toxteth Park, Liverpool.*
857	1894. Nov.	**Priest**, Frank Edward, ASSOC.M.INST.C.E., 13, *Harrington Street, Liverpool.*
879	1894. Dec.	**Prouse**, Oswald Milton, ASSOC.M.INST.C.E., *Alvington, Ilfracombe, Devon.*
872	1894. Nov.	**Reynolds**, Ernest John, ASSOC.M.INST.C.E., *Local Board, Friern Barnet, N.*
861	1894. Nov.	**Richardson**, Richard T., M.B., C.M., M.O.H., 128, *Sheil Road, Liverpool.*
873	1894. Nov.	**Rideal**, Samuel, D.SC.(LOND.). F.I.C., F.C.S., 28, *Victoria Street, Westminster, S.W.*
880	1894. Dec.	**Ross**, J. Maxwell, M.A., M.B., B.SC., F.R.C.S., M.O.H., *County Buildings, Dumfries, N.B.*
881	1894. Dec.	**Schofield**, Alfred Tayler, M.D., 141, *Westbourne Terrace, Hyde Park, W.*
841	1894. Oct.	†**Schneider**, Edward Albert, 5, *Invicta Road, Westcombe Hill, Blackheath, S.E.*
843	1894. Oct.	**Silver**, Stephen William, F.L.S., *Letcomb Manor, Wantage. Berks.*
848	1894. Nov.	†‡**Taylor**, James, 1, *Ely Villas, Stanhope Street, Hereford.*
874	1894. Nov.	**Thomas**, T. W., M.R.C.S., L.S.A., M.O.H., *Sunnyside, Caerphilly, Glamorganshire.*
865	1894. Nov.	**Vereker**, Charles V., L.R.C.P.I., L.R.C.S.I., M.O.H., *Holly House, Woolton, Liverpool.*
852	1894. Dec.	**Watson**, George Alexander, M.B., M.R.C.S., L.R.C.P., D P.H., 626, *High Road, Tottenham, N.*
866	1894. Nov.	**Whitaker**, George Henry, L.R.C.S., L.R.C.P., M.O.H., *Winter Hey House, Horwich, Bolton-le-Moors.*
875	1894. Nov.	**Willcox**, J. Edward, ASSOC.M.INST.C.E., *Union Chambers*, 63, *Temple Row, Birmingham.*
863	1894. Dec.	**Wray**, George Bury, M.R.C.S., L.S.A., D.P.H., 26, *Annesley Grove, Nottingham.*
858	1894. Nov.	**Yates**, Oswald Vavason, ASSOC.M.INST.C.E., *Wellback, Sandbach, Cheshire.*

ASSOCIATES (Assoc. San. Inst.)

‡ Passed Examination as Inspector of Nuisances.

1004	1894. Nov.	‡**Atkinson**, Arthur Herbert, 13, *Brunswick Avenue, St. George's Road, Hull.*
1023	1894. Nov.	‡**Aris**, Frederick Alexander, *Vestry Hall, St. George's, Hanover Square, W.*
995	1894. Oct.	‡**Bache**, Arthur Edmund, 7, *Park Row, Greenwich, S.E.*
996	1894. Oct.	**Bampfylde**, Edward, *Montrose, Frances Road, Windsor.*

Reg. No.	Date of Election.	
1005	1894. Nov.	‡Bottomley, Albert Edward, 83, *Illingworth, Halifax.*
1024	1894. Dec.	‡Brooks, Joseph, *Belgrave House, Denmark Road, Norwich.*
1011	1894. Nov.	‡Bush, Spencer, 40, *Inville Road, Walworth, S.E.*
1012	1894. Nov.	‡Chapman, Shafto John, 5, *Carshalton Road, Lakenham, Norwich.*
1013	1894. Nov.	‡Charlesworth, James Frederick, 178, *Borough Road, Birkenhead.*
1014	1894. Nov.	‡Clarke, John Henry, *Vestry Hall, Chiswick, W.*
1015	1894. Nov.	‡Cooper, James, *Sanitary Department, Municipal Offices, Liverpool.*
997	1894. Oct.	‡Crowther, Charles, *Green Mount, Dewsbury, Yorkshire.*
998	1894. Oct.	‡Debnam, Alfred William John, 3, *Outram Terrace, Stoke, Devonport.*
999	1894. Oct.	‡Franks, Frederick William, *St. Ann's Hill Road. Nottingham.*
1006	1894. Nov.	‡Garbutt, Miss Alice, *High Street, Stockton-on-Tees.*
1027	1894. Dec.	Gardner, Henry George, 10, *Thistlewaite Road, Clapton, S.E.*
1007	1894. Nov.	‡Garner, Albert, 61, *Harrison Street, Bloxwich, Staffs.*
1032	1894. Dec.	‡Gray, Arthur James, 64, *Lodge Road, Hockley, Birmingham.*
1000	1894. Oct.	‡Hart, Mrs. Ellen Louisa, 378, *Green Lanes, Fins-Park, N.*
1028	1894. Dec.	‡Herriott, Harry, *Vestry Hall, St. George's, Hanover Square, W.*
1016	1894. Nov.	‡Hilton, Henry, 14, *Ashton Street, Lytham.*
1026	1894. Dec.	‡Hudson, Albert Edward, 9, *Bangor Street, Halifax.*
1017	1894. Nov.	‡Jarvis, W. Nat., *Kingsbridge, South Devon.*
1008	1894. Nov.	‡Jones, Charles, 97, *Watson Street, Birkenhead.*
1018	1894. Nov.	Kassell, John, *Kirkby Lonsdale, Westmoreland.*
1019	1894. Nov.	‡Keay, Miss Margaret J., *Gerald Street, Higher Grade School, Derby.*
1001	1894. Oct.	‡Kent, Arthur, *Cemetery Road, Shelton Stoke-on-Trent.*
1020	1894. Nov.	‡Knox, William, 3, *Duke Street, Ayr, N.B.*
1029	1894. Dec.	Lowe, Thomas, *Rue des Roses, Cannes, France.*
1002	1894. Oct.	‡Moore, John, 15, *Plummer Street, Newcastle-on-Tyne.*
1025	1894. Dec.	Peel, Thomas George, *Oulart Villa, Armagh, Ireland.*
1030	1894. Dec.	‡Prescott, Thomas Spencer, *Town Hall, Gorton, Lancashire.*
1031	1894. Dec.	‡Priestley, John A., 51, *Lomeshaye Road, Nelson, Lancashire.*
1009	1894. Nov.	‡Shea, Sidney, 24, *Fleet Street, Torquay.*

Reg. No. Date of Election.

1021 1894. Nov. ‡Terry, John, 24, *Moorgate, Bury, Lancashire.*

1010 1894. Nov. ‡Thompson, Frederick William, 4, *Christine Terrace, Clapham, S. W.*

1003 1894. Oct. ‡Warrington, John James, 13, *Scarboro' Terrace, Elland, Yorkshire.*

1022 1894. Nov. ‡Winkworth, Harvey, *Goring Heath, Reading.*

CONTRIBUTIONS AND ADDITIONS TO LIBRARY.

October to December 31st, 1894.

⁂ *For publications of Societies and Institutions, &c., see under "Academies."*

ACADEMIES (American).

Ontario. *Association of Executive Health Officers.* Report of the 9th Annual Meeting, held at Chatham, Ontario, August 14th and 15th, 1894. 163 p., 8vo. Toronto, 1894. *The Association.*

ACADEMIES (Continental).

Leipzig. *Landes-Medicinal-Collegiums.* Fünfundzwanzigster Jahresbericht über das Medicinalwesen im Königreiche Sachsen auf das Jahr, 1893. 350 p., 8vo. Leipzig, 1894. *Dr. Günther.*

ACADEMIES (British).

Glasgow. *Institution of Engineers and Shipbuilders in Scotland.* Transactions, Vol. XXXVII. 1893-94. 254 p., 8vo. Glasgow, 1894. *The Institute.*

London. *City of London College.* Calendar 1894—95. 190 p., 16mo. London, 1894. *The College.*

——— *Incorporated Association of Municipal and County Engineers.* Proceedings, Vol. XX. 1893-94. 383 p., 8vo. London, 1894. *The Association.*

——— *Medical Society of.* Transactions, Vol. XVII. 1894. 363 p., 8vo. London, 1894. *The Society.*

——— *Royal College of Surgeons.* Calendar, 1894. 326 p., 8vo. London, 1894. *The College.*

——— *St. Thomas's Hospital.* Reports. New Series, Vol. XXII. 1892-93. 721 p., 8vo. London, 1894. *The Hospital.*

——— *University College.* Calendar, 1894—95. 441 p., 8vo. London, 1894. *The College.*

——— *Royal Institute of British Architects.* Calendar, 1894-95. 311 p., 8vo. London, 1894. *The Institute.*

——— *Royal Statistical Society.* Journal of, Vol. LVII. 1894. 8vo. London, 1894. *The Society.*

London. *The Surveyors' Institution.* Transactions, Session 1893 94. 8vo. London, 1894. *The Institution.*

Newcastle-upon-Tyne. *North of England Institute of Mining and Mechanical Engineers.* Transactions, Vols. XLIII. and XLIV. Part I. Annual Report. 8vo. Newcastle-upon-Tyne, 1894.

Armagh, Urban Sanitary Authority. Report of Delegates to Congress of The Sanitary Institute at Liverpool, September 24th, 1894. *T. G. Peel.*

Board of Agriculture. Agricultural Returns, Statistical Tables showing acreage under crops and grass, and the number of horses, cattle, sheep, and pigs in the United Kingdom, with particulars of each county of Great Britain, 1894. 37 p., 8vo. London, 1894. *The Board.*

Brussels. *Ministere de l'Agriculture de l'industrie et des travaux publics.* Rapports des Commissions Médicales Provinciales sur leurs Travaux pendant l'Annee. 13 Vols., 8vo. 1881—1893. *Ministere de l'Agriculture.*

——— Bulletin Spécial du Service de Santé de l'Hygiène Publique (January to October, 1894). 8vo. *Ministere de l'Agriculture.*

——— Annee, 1893. 477 p., 8vo. Bruxelles, 1893. *Ministere de l'Agriculture.*

Bucharest. Raport General asupra Igiene Publice si asupra serviciului sanitar ale. Regatului Romainei pe anul, 1893. 204 p., 8vo. Bucharest, 1894. *Dr. J. Felix.*

Calcutta. Report of the Medical Officer for 1893. 126 p,, 8vo. Calcutta, 1894. *Dr. W. J. Simpson.*

Coplin, *Dr. W. M. L. and* **Bevan,** *Dr. D.* A Manual of Practical Hygiene. 456 p., 8vo. Philadelphia. *P. Blakiston, Son & Co.*

Crookshank, *Prof. E. M.* The Prevention of Small-pox, with special reference to the origin and development of the Stamping-out System. 40 p., 8vo, London, 1894. *The Author.*

Davies, *Dr. Sidney.* How to avoid Doctors' Bills. Six Lectures on Public Health and Preventable Disease. 28 p., 8vo. Woolwich. *The Author.*

Dutton, *Dr. Thomas.* Domestic Hygiene. 199 p., 8vo. London, 1894. *The Author.*

Ferguson, *Dr. R. Bruce.* Aids to the Mathematics of Hygiene. 89 p., 16mo. London, 1894. *The Author.*

General Board of Health. Reports of Superintending Inspectors on the Sewerage, Drainage, Water Supply, and General Sanitary condition of towns in England and Wales. Vols. I. to XXVI. 8vo. *Purchased.*

Halton, *R. J.* Short Lectures on Sanitary Subjects. 192 p., 8vo. London, 1874. *Rogers Field.*

Hinsdale, *Dr. Guy.* The comparative rarity of Pulmonary Tuberculosis in the Highlands of Pennsylvania and the adjacent counties of New York. 10 p., 8vo. Reprint from the *Medical News,* August 4th, 1894. *The Author.*

Hood, *C.* A Practical Treatise upon Warming Buildings by Hot Water, and upon Heat and Heating Appliances in general. Re-written by Frederick Dye. 2nd New Edition. 520 p., 8vo. London, 1894. *Frederick Dye.*

Jacob, *Prof. E. H.* Notes on the Ventilation and Warming of Houses, Churches, Schools, and other Buildings. 124 p., 16mo. London, 1894. *Purchased.*

Japan. A brief Review of the operations of the Home Department in connection with the Cholera Epidemic of the 23rd year of Meiji (1890). 182 p., 8vo. Tokyo, 1890.

——— The Annual Report of the Central Sanitary Bureau, attached to the Home Department of the Imperial Japanese Government for the 23rd year of Meiji (1890). 165 p., 8vo. Tokyo, 1890. *Director of the Sanitary Bureau.*

Legge, *Dr. T. M.* Sanitation of Paris, Brussels and Berlin. 45 p., 4to. Reprint from the Medical Magazine, 1893. *The Author.*

Local Government Board. Dr. H. Timbrell Bulstrode's Report on an Outbreak of Diphtheria at Hythe, and at Bramshaw in the New Forest Rural Sanitary District. 10 p., f.cap. London, 1894.

——— Dr. T. W. Thompson's Report upon an Outbreak of Diphtheria in the parish of Barnham Broom within the Farehoe Rural Sanitary District. 12 p., f.cap. London, 1894.

——— Dr. Thomas Horne's Report on Scarlatina Prevalence in the Hucknal Torkard Urban Sanitary District, and on Administration by the Sanitary Authority. 6 p., f.cap. London, 1894. *Dr. Thorne Thorne.*

London Building Act, 1894. 111 p., 4to. London, 1894.

London, City of. *Commissioners of Sewers of.* *Purchased.*

Reports for the years 1848-49. 8 Vols. 8vo. London.

Sanitary Reports by the Medical Officers of Health for the years 1849-67 and 1872-84. 4 Vols. 8vo. London.

Engineers' Annual Reports for the years 1849-87. 2 Vols. 8vo. London.

Accounts for the years 1851-86. 2 Vols. 8vo. London.

Reports on Electric Lighting for the years 1878-85. 1 Vol. 8vo. London.

Reports on Artizans' and Labourers' Dwellings. 1868-85. 1 Vol. 8vo. London.

Reports on Improvements. 1865-86. 1 Vol. 8vo. London.

Reports on Water Supply. 1850-51. 1 Vol. 8vo. London.

Reports on Sewage. 1848-83. 1 Vol. 8vo. London.

Reports on Pavements. 1847-87. 1 Vol. 8vo. London.

Reports on Scavenging, Dusting, Washing, and Snow. 1851-85. 1 Vol. 8vo. London.

Report on Cemeteries. 1853-84. 1 Vol. 8vo. London.

Report on Gas Lighting. 1853-83. 1 Vol. 8vo. London.

Reports on Tramways, Bridges, and Subways. 1858-85. 1 Vol. 8vo. London.

Reports, Parliamentary, 1868-70. 1 Vol. 8vo. London. *Purchased.*

London County Council. By-Laws and Regulations. 235 p., 16mo. London, 1893. *Purchased.*

Massachusetts. Twenty-fifth Annual Report of the State Board of Health, 1893-94. 812 p., 8vo. Boston, 1894. *The Board.*

McNeill, *Dr. Roger.* The Prevention of Epidemics and the Construction and Management of Isolation Hospitals. 238 p., 8vo. London, 1894. *J. & A. Churchill.*

MEDICAL OFFICERS OF HEALTH AND OTHER SANITARY REPORTS.

Hackney, 1893	*Dr. J. King Warry.*
Lancaster C. C., 1893	*Dr. E. Sergeant.*
St. Pancras, 1893	*Dr. J. F. J. Sykes.*
Warwick C. C., 1893	*Dr. Bostock Hill.*

Metropolitan Commission of Sewers. Minutes, 1849-55. 5 Vols., royal 8vo. Reports, &c., 1849. 2 Vols., 8vo. Reports, Papers, and Sections, 1851-55. 4 Vols., 8vo. *Purchased.*

Migula, *Dr. W.* An Introduction to practical Bacteriology for Physicians, Chemists and Students. (Translated by M. Campbell and edited by Dr. H. J. Campbell.) 247 p., 8vo. London, 1893. *Dr. H. J. Campbell.*

Newcastle-upon-Tyne. *North of England Institute of Mining and Mechanical Engineers.* Report of the Proceedings of the Flameless Explosives Committee. Part I.—Air and Combustible Gases. 69 p., 8vo. London and Newcastle, 1894. *The Institute.*

Ontario. Twelfth Annual Report of the Provincial Board of Health, being for the year 1893. 173 p., 4to. Toronto, 1894. *The Board.*

Paget, *Charles E.* Some Lectures by the late Sir George E. Paget, K.C.B., M.D., F.R.S. 181 p., 8vo. Cambridge, 1893. *The Author.*

Paterson, *E. J.* The Hermite System of Sanitation of Towns by Electricity. 18 p., 16mo. Reprint from the "Surveyor." *The Author.*

Public Health Act, 1875, and other Statutes and parts of Statutes relating to the Public Health, with complete index by F. Stratton. 8vo. London, 1894. *Purchased.*

Registrar-General (Ireland). Thirtieth Annual Report, containing a general abstract of the numbers of Marriages, Births, and Deaths registered in Ireland during the year 1893. 195 p., f.cap. Dublin. *Registrar-General.*

Registrar-General (Scotland). Thirty-eighth Detailed Annual Report of Births, Deaths, and Marriages. (Abstracts of 1893.) 481 pp., royal 8vo. Edinburgh, 1894. *Registrar-General.*

Reid, *Dr. George.* Practical Sanitation. 2nd Edit. 304 p., 8vo. London, 1893. *The Author.*

Richards, *J.* Purification of Sewage. 46 p., 8vo. Manchester, 1893. *H. Lockwood.*

Roechling, *H. A.* Rivers Pollution and Rivers Purification. 48 p., 8vo. Read at Meeting of Municipal and County Engineers' Association at Bury, July, 1892. *The Author.*

——— The Sewage Farms of Berlin. Excerpt Proceedings of the Institution of Civil Engineers, Vol. CIX., Part III. 131 p., 8vo. London, 1892. *The Author.*

Rome. Di un nuovo apparechio per la Raccolta del siero di sangue per il Dr. Achille Sclavo. 5 p., f.cap. Rome, 1894.

——— Sulle cause che Determinano nella practica delle disinfezioni la scomparsa del mercurio dalle soluzioni di Sublimato corrosivo. Nota dei. Dr. Achille Sclavo e Camillo Manuelli. 6 p., f.cap. Rome, 1894. *Ministero dell' Interno.*

Snell, *Simeon.* On the Relations of some Occupations to Eyesight. Reprint *Quarterly Medical Journal*, Vol. III., Part I. 16 pp., 8vo. London, 1894. *The Author.*

Squire, *Dr. J. Edward.* The Hygienic prevention of Consumption. 194 p., 8vo. London, 1893. *The Author.*

Stevenson & Murphy. Hygiene and Public Health. Vol. III. "Sanitary Law." 459 p., royal 8vo. London, 1894. *J. & A. Churchill.*

Symons, *G. J.* Symons's British Rainfall, 1891. 228 p., 8vo. London, 1892.

——— 1892. 223 p., 8vo. London, 1893.

——— 1893. 239 p., 8vo. London, 1894. *The Author.*

United States Army. Index Catalogue of the Surgeon-General's Office, Volume XV. 842 p., 4to. Washington, 1894. *The Surgeon-General U. S. Army.*

Vacher, *Francis.* A Healthy Home. 204 p., 16mo. London, 1894. *The Author.*

Valon, *W. A. McIntosh.* Address to the Meeting of the Sanitary Inspectors' Association, at Ramsgate, August 17th, 1894. 12 p., 16mo. London, 1894. *The Author.*

Ventilation. Reports on the Ventilation of the Capitol Washington, U.S., and the Chamber of Deputies, Paris. 8 p., 8vo. Reprint from the *Building News*, August 17th, 1894.

——— A Danger to Public Health. Two Parts. 28 p., 16mo. Reprints from the *Local Government Journal*, September 1st and October 13th, 1894. *W. Whitaker.*

Walker, *J.* Walker's Handbook of Domestic Hot Water Fitting, Explosive and Non-Explosive. 32 p., 8vo. Liverpool. *The Author.*

Willoughby, *Dr. E. F.* Handbook of Public Health and Demography. 508 p., 8vo. London, 1893. *The Author.*

GENERAL INDEX.

PAGE

ADAMS, Dr. F. E., on W. Midgley's paper 699
Ainley, Dr. on J. C. Broom's paper 672
Air-baths, therapeutic effect of... 192
Air movements and barometrical conditions, by R. H. Scott 188
„ space in hospitals, necessity of large amount of 19, 20
Air temperature 180
„ „ etc., at Greenwich, table showing ... 204
Alkali works of Widnes and Oldbury, tables relating to the operatives in the 715-723
Annual Report of the Council for 1893.................................. 53
Argentine Republic, quarantine in the, by F. P. Hansen 552
Arlidge, Dr. J. T., on Dr. Reid's paper 506
„ on position of the study of industrial diseases......... 517
Armstrong, Dr. H. E., on W. Defries and W. Daley's papers 534
„ on Prof. Roche's paper...... 523
Asphalte pavement, sanitary qualities of 144
„ as a perfect damp-proof course 42
Associates elected, 1894, 76, 322, 491, 772
Atlantic Ocean, changes of temperature in the..................... 179
Atmosphere of Liverpool, by T. Lewis Bailey, and Charles A. Kohn 742
Atmospheric air, effect of heat on 173
Awards made by Judges at the Liverpool Exhibition 463

BACILLUS coli and typhoid bacillus, action of in sewage 351
„ of typhoid, characters of ... 347

PAGE

Bacteria in Water, effects of 377, 378
Bailey, T. Lewis, on the atmosphere of Liverpool 742
Bakehouse regulation Act, 1863 27
Bakehouses, description of underground........................ 24
„ insanitary condition of underground............ 22, 23
„ necessity for increased inspection of 36
„ necessity for the ventilation of 32
Bakery, principles for the construction of a sanitary 26
Balance sheet, general, 31st Dec. 1893 74
Barometer, description and uses of 157
Barometrical conditions and air movements, by R. H. Scott........................... 188
„ pressure, periodical and non-periodical changes of 188, 189
Beckley's rain gauge, figure of... 208
Beloe, Councillor Charles H., on papers by W. Darley and S. R. Lowcock 688, 689
Bibliography of hygiene, a contribution to a, prepared by G. J. Symons 89, 275
Black, Surgeon-Major, on W. Henman's paper 650
Blair, W. N., on Major Isaac's paper 149
Blandy, John, on Dr. F. J. Waldo's paper 33
Blyth, Prof. A. Wynter, on legislation and law cases, 117, 288, 480, 760
Boiler (domestic), explosions and cylinder collapses, their cause and cure, by James Walker ... 663
Boulnois, H. P., on housing of the working classes, tenement houses or dwellings in flats ... 611

PAGE

Boulton, Alderman, on Alderman Noton's paper 677
" on G. J. C. Broom's paper... 672
" on Dr. Reid's paper. 507
Braien, B.A., on Dr. F. J. Waldo's paper 34
Brand, J., on Prof. Roche's paper. 525
Bricks, quality of, used for walls of houses 49
British Islands, varieties of temperature in the 185
Broom, G. J. C., on the Tub and Pail System 664
Brown, Dr. Campbell, on W. Midgley's paper 697
Brown, Dr. J., on Alderman C. Burt's paper 551
" on Dr. Marsden's paper 559
" on Dr. Reid's paper 503
" on Prof. Roche's paper 523
Budapest, Congress of Hygiene at, 1894, by Dr. J. F. J. Sykes 471
" 1894, Hygiene and Demography Congress to be held at, by Dr. Paul F. Moline. 272
" progress of public health work at, by Dr. Fodor ... 112
Building construction, sanitary, by Keith D. Young 37
Burial of the dead, by C. H. Cooper 567
Burt, Alderman C., on laws relating to the acquisition of land for isolation hospitals, workmen's dwellings, and public improvements 541
" on A. Kent's paper 639
" on papers by Prof. Robinson, Prof. E. Hull, and W. Spinks 599, 602

CONGRESS at Liverpool, 1894... 310
" " Inaugural Address to, by Sir Francis Sharp Powell, Bart, M.P. 329
" at Rome, Eleventh International Medical, 1894, by Dr. Dawson Williams 266
Construction of Roads and Streets from a Sanitary point of view, by Lewis H. Isaacs 137
Contagious nature of tubercle ... 445
Contributions and additions to Library, 1894 ......81, 325, 492, 772
Cooper, C. H., on the burial of the dead 567
" on Lieut.-Col. Jones' paper 633
Cooper, C. H., on A. Kent's paper 639
" on papers by Prof. Robinson, Prof. E. Hull, and W. Spinks 598
Corfield, Prof. W. H., on Dr. F. J. Waldo's paper 31
Council, annual report of the, for 1893 55
Craven, Dr. Musgrave, on Dr. Reid's paper 516
Crawford, Sir Thomas, on A. Kent's paper 640
" on W. Henman's paper 650
" on W. Tate's paper 742
" on Dr. R. Thorne Thorne's paper 20
" on Prof. Roche's paper 524
Crichton-Browne, Sir James, lecture to the working classes by 430
Curtin, W. H., on cholera in Hull, 1893, from an inspector's point of view 559
Cameron, Sir Charles, on W. Defries and W. Daley's papers 534
" on A. E. Fletcher's paper 727, 728
" on Dr. Kohn's paper 692
" on papers by Prof. Robinson, Prof. E. Hull, and W. Spinks 597
" on Prof. Roche's paper...521-525
Cameron, Dr. Spottiswoode, on W. Defries and W. Daley's papers 534
Cemetery, table of analysis of clay from the Lambeth 574
Chimneys in Bolton and Oldham, the application of the simultaneous method of observing, by Herbert Fletcher 751
Cholera in Hull, 1893, from an inspector's point of view, by W. H. Curtin 559
" nature of disease poison ... 244
Clare, Dr. J., on Prof. Roche's paper 526
Cleansing of roads and streets, methods for 140
Climate in relation to health, by Dr. C. Theodore Williams 216
Climates most beneficial to health 227, 229
Climatological work, necessary outfit for 164
Clouds, their effect on radiation.. 183
" uses of 239
Cloud, two main classes of, as they appear in nature 236, 237

PAGE

Cold as affecting health 221
„ storage: its effects upon our food supply, by Frank Tate 731
Collins, Arthur E., on Major Isaac's paper 150
Collins, H. H., on papers by W. Goldstraw and H. P. Boulnois 624, 625
Compston, Councillor, on W. Defries and W. Daley's papers 533
„ on W. Henman's paper...... 650
Congress, closing General Meeting of the 462
„ of Hygiene at Budapest, 1894, by Dr. J. F. J. Sykes 471
Congresses held by the Institute xiii

DALEY, W., on disinfection 532
Damp, means to exclude from our houses 40, 42, 43
Darley, W., on the purification of sewage and foul waters by means of the magnetite filter.. 678
Davies, E., on Dr. Kohn's paper.. 692
Deacon, George F., address to Section II.—Engineering and architecture 353
„ on G. J. C. Broom's paper.. 673
„ on A. Kent's paper......639, 640
„ on Lieut.-Col. Jones' paper.. 634
„ on papers by W. Darley and S. R. Lowcock 689
„ on papers by D. Goldstraw and H. P. Boulnois 621
„ on papers by Prof. Robinson, Prof. E. Hull, and W. Spinks 596, 601
„ on R. Williams' paper 662
Dead, burial of the, by C. H. Cooper 567
Death-rate (annual) per 1000 in London, &c., in 1854 and 1891-4. Tables showing 654
„ „ from diphtheria in London 8
Death-rates from diphtheria in England and Wales. Map showing 8
„ „ in various towns since the commencement of the tub and pail system. Tables showing the ... 672
Defries, Wolf, on the theory and practice of disinfection by heat 528

PAGE

Denham, H., on Lieut.-Col. Jones' paper 634
Diagram of barometer, thermometer, rain, and wind at Camden Square, London, March, 1894.................. 168
„ of barometer, thermometer, rain, and wind, explanation of 165
Diphtheria caused by milk infection 16, 17
„ death-rate from, in London 8
„ death-rates in England and Wales. Map showing ... 8
„ and enteric fever, table showing annual mortality from 11
„ the etiology, spread and prevention of, by Dr. R. Thorne Thorne 7
„ infectious nature of ...12, 18, 19
„ influence of sanitary surroundings on 9, 10
„ influence of schools on the spread of 14, 15
Disease in meat, jaundice and bile-staining as a sign of, by Dr. R. Sydney Marsden 557
Disease-microbes, affects of association with fluviatile saprophytes on 247
„ in water, vitality of 245
Disease, pawnbroking establishments a source of the spread of, by Prof. A. Roche 527
„ poisons of typhoid fever and cholera, nature of the 243
„ possibility of the spread of, through river waters supplied to London, by Dr. Louis C. Parkes 243
„ tubercular, prevention of... 430
Diseases, industrial, position of study of, by Dr. J. T. Arlidge . 517
Disinfection by heat, the theory and practice of, Wolf Defries 528
„ by W Daley..................... 532
Disposal of sewage in the United States 257
Domestic hygiene, address by the Lady Mayoress of Liverpool to the conference of ladies on ... 413
Dwelling-houses, means to exclude damp from our 40, 42, 43
„ roof-coverings of 45
Dwelling-rooms, ventilation and lighting of 50

PAGE

ECCLES, A. E., on Dr. Reid's paper ... 509
Eddy, Harrison, on Lt.-Col. Jones' paper ... 633
Electrolytis and its application to the detection of mineral poisons, by Dr. Charles A. Kohn. 691
Emigrant life on board ship, improvement in sanitation of...... 383
Enteric fever and diphtheria, table showing annual mortality from ... 11
Etiology, spread and prevention of diphtheria, by Dr. R. Thorne Thorne ... 7
Evaporation gauges, various kinds of ... 206
„ in various parts of the world, table showing...... 208
Exhibits to which awards have been made... 86
Expenditure and Income for 1893 ... 72

FACTORIES, chemical, the health of the workmen in, by A. E. Fletcher ... 702
Factory legislation, infant mortality and female labour in relation to, by Dr. G. Reid ... 497
Factory and Workshop Act, 1891 30
Fellows, members, and associates, elected 1894 ......76, 322, 491, 772
Female workers, protection of the health of, with special reference to pregnancy and wet nursing, by Dr. Hugh Richard Jones ... 511
Field, Rogers, on Major Isaac's paper ... 148
Filtration, its importance in the purification of water ... 379
Filtration of sand, effect of 252
Fletcher, A. E., on the health of the workmen in chemical factories ... 702
„ on papers by Dr. T. L. Bailey, Dr. A. C. Kohn, and H. L. Terry ... 750
Fletcher, Herbert, on the application of the simultaneous method of observing chimneys in Bolton and Oldham ... 751
Floods in rivers, effects of, on the water supply... 255
Flower, Major Lamorock, on Alderman Noton's paper 677
„ on Lieut.-Col. Jones' paper 633
„ on A. Kent's paper... 640

PAGE

Flower, Major Lamorock, on papers by Prof. Robinson, Prof. E. Hull, and W. Spinks ... 601
Fluviatile Saprophytes, effects on disease microbes of association with ... 247
Fodor, Dr., on the progress of public health work at Budapest... 112
Fog, cloud, and sunshine, by F. Gaster... 231
Fogs, causes of... 231
„ evil effects of 232, 233, 235
Food supply, the effects of cold storage upon our, by Frank Tate ... 731
Forwood, Sir William B., address to conference on the sanitation of the passenger and mercantile marine service ... 382
Fowler, A. M., address to conference of Municipal and County Engineers ... 403
Furnace Management... 756
Fyfe, P., on papers by W. Goldstraw and H. P. Boulnois 626

GALTON, Sir Douglas, on Major Isaac's paper ... 147
„ on Dr. R. Thorne Thorne's paper ... 20
„ on the teaching of hygiene in elementary schools..... 534
Gases, thermal changes of... 171
Gaster, F., on Fog, Cloud and Sunshine... 231
General Notes ...132, 300
Gilby, C., on papers by Prof. Robinson, Prof. E. Hull, and W. Spinks... 600
Glaisher's Hygrometrical Tables. 203, 206
Goldstraw, W., on Housing of the Working Classes; sanitary powers relating thereto in Liverpool, by ... 605
Gorniot, T. A., on Dr. F. J. Waldo's paper ... 73

HANSEN, F. P., on Quarantine in the Argentine Republic...... 552
Harrison, T. H., on W. Henman's paper ... 651
Heat as affecting health 218, 222
„ effect of, on atmospheric air 173
„ effect of, on water... 172
„ the theory and practice of disinfection by, by Wolf Defries ... 528

PAGE
Hele-Shaw, Prof. H. S., on J. Walker's paper 664
„ on R. Williams' paper 661
Henman, W., on purification of air emitted from hospitals for the treatment of infectious diseases 641
Hill, Dr. A., on Dr. Kohn's paper 693
Hime, Dr. T. Whiteside, on preventive measures for stamping out tuberculosis 564
„ on W. H. Curtin's paper ... 563
Hippocrates on the physiological action of winds.................... 195
History of Sanitary Institute...... 1
Hodgson, Dr., on Sir Douglas Galton's paper 539
Holden, Dr. on Dr. Reid's paper.. 504
„ on Prof. Roche's paper...... 525
Hooper, Mr. on Major Isaac's paper 150
Hospitals, necessity of large amount of air space in 19, 20
Houses, overcrowding of, upon land, evil effects of 417
Housing of the poor and working classes, necessity for improvement in the 403
„ working classes, sanitary powers relating thereto in Liverpool, by W. Goldstraw 605
„ „ tenement houses or dwellings in flats, by H. P. Boulnois 611
Hudson, E. W., on the importance of clean roads 153
Hull, Cholera in, 1893, from an Inspector's point of view, by W. H. Curtin....................... 559
Hull, Prof. Edward, on water-supply of the Borough of St. Helens, Lancashire, from wells in the new red sandstone 578
Hydraulic Formulæ, by Henry Law 282
Hygiene, contribution to a bibliography of, prepared by G. J. Symon 89, 275
„ and Demography Congress, to be held at Budapest, 1894 ....272, 471
„ in elementary schools, teaching of, by Sir Douglas Galton 534
„ at Paris and in France generally, by Dr. Emile Vallin 259

PAGE
Hygrometers, classification and description of 200, 201, 202
Hygrometrical readings taken in cotton mills and their reductions, by W. W. Midgley 694
„ tables, Glaisher's.........203, 206

INCOME and Expenditure for 1893.. 72
Industrial Diseases, position of the study of, by Dr. J. T. Arlidge 517
Infant mortality and female labour in relation to factory legislation, by Dr. George Reid 497
Infectious diseases, purification of air emitted from hospitals for the treatment of, by W. Henman.............................. 641
Infectious nature of diphtheria, 12, 18, 19
Inspection of bakehouses, necessity for increased.................. 36
Institute, History of 1
Institute, forthcoming meetings of the.........129, 309, 485, 766
„ meetings of the, 1894 ...... 85, 307, 484, 765
Isaacs, Lewis H., on road and street construction from a sanitary point of view 137

JAUNDICE and bile-staining a sign of disease in meat, by Dr. R. Sydney Marsden............... 557
Jones, Dr. Herbert, on Professor Roche's paper 525
Jones, Dr. Hugh Richard, on the protection of the health of female workers with special reference to pregnancy and wet nursing 511
Jones, Lt.-Col. A. S., on the vital difference between well managed and neglected sewage farms 628

KENEALY, Miss Annesley, on Dr. Reid's paper 507
Kent, Arthur, on willow farming as a profitable means of utilizing sewage effluent 635
Kenyon, Dr. G. A., on W. Henman's paper 651
Klein, Dr. E., address to Section I., sanitary science and preventive medicine 343
Koch on the tubercle bacilli...... 433

PAGE

Kohn, Dr. C. A., on the application of electrolytis to the detection of mineral poisons ... 691
,, on the atmosphere of Liverpool ... 742

LAKEMAN, W. G., on Dr. F. J. Waldo's paper ... 32
Lakes, temperature changes in fresh water ... 177
Land laws relating to the acquisition of, for isolation hospitals, workmen's dwellings, and public improvements, by Alderman C. Burt ... 541
Law, Henry, on hydraulic formulæ ... 282
Laws relating to the acquisition of land for isolation hospitals, workmen's dwellings, and public improvements, by Alderman Charles Burt ... 541
Lecture to the congress, by Dr. Longstaff ... 417
,, to sanitary officers, building construction ... 37
,, to the working classes by Sir James Crichton-Browne ... 430
Legislation and law cases, notes on, prepared by Prof. A. Wynter Blyth ...117, 288, 480, 760
Lemon, James, on Alderman C. Burt's paper ... 550
Library, contributions and additions to, 1894 ...81, 325, 492, 772
Light, its importance in the purification of river water 251, 378
,, as a preventive against tubercular disease ...457, 459
Liverpool, the atmosphere of, by T. Lewis Bailey, and Charles A. Kohn ... 742
,, congress programme ... 310
,, disposal of sewage of...356, 358
,, exhibition, awards made by judges at the ... 463
,, housing of the working classes, sanitary powers relating thereto in, by W. Goldstraw ... 605
,, inaugural address to the congress at, by Sir Francis Sharp Powell, Bart., M.P. 329
,, water supply, improvement in the ...355, 362
Local Government Act, 1888, on medical officers' diplomas..389, 393, 399, 402

PAGE

London, death-rate from diphtheria ... 8
,, mean monthly rainfall from 1813—72, table showing ... 210
,, the possibility of the spread of disease through the river waters supplied to, by Dr. Louis C. Parkes... 243
,, water supply, necessity for improvements in the 366, 370
Longstaff, Dr., lecture to the congress, by ... 417
Lowcock, S. R., on papers by Prof. Robinson, Prof. E. Hull, and W. Spinks ... 602
,, on Alderman Noton's paper ... 677
,, on Lowcock's system of sewage filtratlon ... 685
Lyon, Washington, on Alderman C. Burt's paper ... 550
,, on Prof. Roche's paper ... 523
,, on Sir Douglas Galton's paper ... 538
,, on W. H. Curtin's paper ... 563

MACADAM and gravel roads, unhealthy nature of... 145
Maclay, Councillor W., on Sir Douglas Galton's paper ... 540
Magnetite filter, purification of sewage and foul waters by means of the, by W. Darley ... 678
Malaria and its causes...223, 225
Map showing average diphtheria death-rates in England and Wales ... 8
,, ,, rainfall of the British Isles, by G. J. Symons. 208
Marine Service, passenger and mercantile, address to conference on ... 382
Marriott, W., on moisture, its determination and measurement ... 200
Marsden, Dr. R. Sydney, on jaundice and bile-staining as a sign of disease in meat ... 557
,, on Dr. G. Reid's paper ... 507
,, on Prof. Roche's paper ... 522
,, on Sir Douglas Galton's paper ... 541
Mason, Charles, on Major Isaacs' paper ... 149
Mawbey, E. G., on Major Isaacs' paper ... 151

PAGE
Mayoress of Liverpool, address to the conference of ladies on domestic hygiene 413
Mechanical stokers 755
Medical council, general, on public health diplomas 389, 400
Medical officers of health, address to conference of, by Charles E. Paget 386
Meetings held during 1894, 85, 129, 307, 309, 484, 485, 765, 766
Members and associates elected, 1894 ....76, 322, 491, 772
Mental and nervous diseases, prevention of, by Dr. J. Shaw ... 564
Meteorological instruments and sanitary work, by G. J. Symons 157
„ observations, table showing 168
Meteorology, list of works dealing with 166, 187
Micro-organisms in water, kinds of 375
Midgley, W. W., on hygrometrical readings taken in cotton mills and their reductions...... 694
Milk infection, a cause of outbreaks of diphtheria .. 16, 17
„ as a vehicle of tubercular infection 451
Mill, Hugh Robert, on temperature of soil, water, and air...... 169
Mineral poisons, the application of electrolytis to the detection of, by Dr. Charles A. Kohn ... 691
Moisture, its determination and measurement, by W. Marriott. 200
Moline, Dr. Paul F., on the congress of hygiene and demography to be held at Budapest, 1894 272
Mortality, annual, from enteric fever and diphtheria, table showing 11
Muir, Dr., on W. Midgley's paper 697
Muspratt, E. K., on A. E. Fletcher's paper 728, 730

NATION'S wealth, the, by Robert Williams 652
Notes, general 132, 300
„ on legislation and law cases, prepared by Prof. A. Wynter Blyth............... 117, 288, 480, 760
Noton, Alderman, on G. J. C. Broom's paper 673
„ on the purification of sewage water for its use for steam and condensing purposes... 674

PAGE
OBITUARY, Inspector-General Lawson, LL.D., Q.H.P. 80
Ocean, average temperature of the whole 179
Officers of the Institute for 1894—95 xii
O'Flaherty, Dr., on Prof. Roche's paper 525
Oulton, Dr., on Sir Douglas Galton's paper........................... 541
Overcrowding of houses upon land, evil effects of 417
Oxidation in river water, effect of 250
Oxygenation of water, results of 377

PAGET, Charles E., Address to Conference of medical officers of health 386
Pain, Coard S., on papers by W. Goldstraw and H. P. Boulnois............................ 625, 626
Paris, Hygiene at, and in France generally, by Dr. Emile Vallin 259
Parkes, Dr. Louis C., on Dr. F. J. Waldo's paper 32
„ on the possibility of the spread of disease through the river waters supplied to London 243
Pavements, asphalte, sanitary qualities 144
„ wood, evils of........... 142, 147
Pawnbroking establishments as a source of the spread of disease, by Prof. A. Roche...... 527
Peck, Dr., on Prof. A. Roche's paper 521, 526
Permewan, Dr., on papers by W. Goldstraw and H. P. Boulnois 623
Phillips, John, on Major Isaacs' paper 151
Physiological action of winds 193, 195
„ influence of changes of pressure 190
Platt, S. S., on G. J. C. Broom's paper 673
„ on A. Kent's paper............ 639
Plummer, W. E., on W. Midgley's paper 699
Poisons, Mineral, the application of electrolytis to the detection of, by Charles A. Kohn 691
Pollution of Rivers, by William Spinks 585
Porter, Dr. Charles, on Dr. Reid's paper 509
Powell, Sir Francis Sharp, address to the Congress at Liverpool by....................... 329

PAGE

Powell, Sir Francis Sharp, on W. Midgley's paper...698, 699
,, on papers by W. Goldstraw and H. P. Boulnois 621
Prevention of mental and nervous diseases, by Dr. J. Shaw... 564
Preventive measures against tubercle 442, 446
,, ,, for stamping out tuberculosis, by Dr. T. Whiteside Hime 564
Priestley, Dr. James, on Dr. F. J. Waldo's paper 35
Public Health Act, 1875...392, 394, 401
,, ,, ,, 1891 .... 27, 29
Public health Work at Budapest, progress of, by Dr. Fodor 112
,, ,, in France, by Dr. Vallin. 259
Pumping stations of new red sandstone wells in Lancashire, table giving particulars of...... 580
Purification of air emitted from hospitals for the treatment of infectious diseases, by W. Henman........ 641
Purification of sewage water for its use for steam and condensing purposes, by Alderman Noton 674

QUARANTINE in the Argentine Republic, by F. P. Hansen...... 552

RADCLIFFE, J., on papers by W. Darley and S. R. Lowcock 689
Radiation, process of 170
Rain, courses of 211, 212
Rainfall in London from 1813—72, table showing mean-monthly 210
,, map of the British Isles, by G. J. Symons 208
,, variations in the annual amount of 214
Rain-gauges, Beckley's and Richard's..................208, 209, 210
Ransome, Dr. Arthur, on vital statistics 108
Reid, Dr. George, on infant mortality, female labour in relation to factory legislation 497
Report, Annual, of the Council, for 1893 53
,, of the Royal Commission on Metropolitan Sewage Discharge, 1884 374
,, of the Royal Commission, 1884 405

PAGE

Reviews of books and parliamentary papers 108, 257, 759
Richard's rain-gauge, figure of ... 209
Rickaby, W., on Prof. Roche's paper 522
,, on Sir Douglas Galton's paper 539
River pollution, by William Spinks 585
Rivers, self-purifying powers of. 594
River water, effect of oxidation in 250
,, ,, supplied to London, possibility of the spread of disease by the, by Dr. Louis C. Parkes 243
Road & street cleansing, methods for 140
,, ,, construction from a sanitary point of view, by Lewis H. Isaacs 137
Roberts, P. Harding, on W. Henman's paper 650
Robinson, Prof. Henry, on water supply 575
Roche, Prof. A., on pawnbroking establishments a source of the spread of disease... 527
,, on the spread of typhoid fever by sewers 520
Rome, 1894, eleventh international medical congress at, by Dr. Dawson Williams 266
Roof-coverings of dwelling-houses 45
Ruskin, Mr., extracts from the storm cloud of the 19th century, by 194

SADLER, A., on G. J. C. Broom's paper 673
Sand filtration, defects of 369
,, ,, effects of 252
Sanitary bakery, principles for the construction of 26
,, building construction, by Keith D. Young 37
,, inspectors, conference of, address by Francis Vacher 409
,, insurance, by Dr. G. Walter Steeves 565
,, matters in the United States, by Col. G. E. Waring ... 264
,, officers, lecture to, on building construction...... 37
,, surroundings, influence of, on diphtheria 9, 10
,, work and meteorological instruments, by G. J. Symons 157

PAGE
Sanitation abroad, notes on...112, 259
„ of the passenger and mercantile marine service, address by Sir William B. Forwood 382
„ of places where food is stored and prepared, by Dr. F. J. Waldo 21
Schools, influence of, on the spread of diphtheria ...14, 15
„ teaching of hygiene in elementary, by Sir Douglas Galton 534
Scott, R. H., on barometrical conditions and air movements 188
Scudder, W., on papers by W. Darley and S. R. Lowcock...... 689
Sedimentation, importance of, in the purification of river water 376
„ of the water, effect of 249
Sergeant, Dr. E., on W. Defries and W. Daley's papers ... 533
„ on Dr. Reid's paper 505
Sewage, action of bacillus coli and of typhoid bacillus in 351
„ disposal, Liverpool......356, 358
„ „ in the United States 257
„ effluent, willow farming as a profitable means of utilizing, by Arthur Kent ... 635
„ farms, the vital difference between well-managed and neglected, by Lt.-Col. Alfred S. Jones 628
„ filtration, Lowcock's system of, by Sydney R. Lowcock 685
„ and foul waters, purification of, by means of the magnetite filter, by W. Darley 678
„ table showing average composition of 590
„ treatment, methods of 359
„ water, the purification of, for its use for steam and condensing purposes, by Alderman Norton 674
Sewers, the spread of typhoid fever, by Prof. A. Roche......... 520
Shaw, James, on the prevention of mental and nervous diseases 564
Shaw, Prof. W. M., on warming and ventilation. Review by H. Law.............................. 110
Skipworth, T P., on Sir Douglas Galton's paper 540

PAGE
Smillie, J., on G. J. C. Broom's paper 673
„ on R. Williams' paper 662
Smoke, town, notes on, by Hubert L. Terry 744
„ method of observing chimneys, by H. Fletcher...... 751
Soil, effect of solar radiation on.. 174
„ water and air temperature, by Hugh Robert Mill ... 169
Solar radiation, apparatus for determining 163
„ „ and its effect on the solid land 174
Spinks, William, on river pollution 585
Sprunt, Mrs., on Sir Douglas Galton's paper 538
Steeves, Dr. G. W., on Professor Roche's paper 521
„ on sanitary insurance 565
Sterhouse, Mr., on papers by W. Darley and S. R. Lowcock...... 689
Stevenson & Murphy's Hygiene. Reviews by Dr. A. Newsholme, H. Law, and A. Wynter Blyth, 108, 109, 759
Stevenson, Thomas, address to Section III. on chemistry, meteorology, and geology 372
Stevenson, Dr. T., on A. E. Fletcher's paper 727, 730
„ on H. Fletcher's paper 758
„ on Dr. Kohn's paper ...691, 693
„ on W. Midgley's paper 696, 701
„ on papers by Dr. T. L. Bailey, Dr. C. A. Kohn, and H. L. Terry 749, 751
„ on F. Tate's paper 742
Stoney, Dr., on Prof. Roche's paper 524
Sunshine, instruments used to record bright 240
Sykes, Dr. J. F. J., on congress of hygiene at Budapest, 1894 471
„ on papers by W. Goldstraw and H. P. Boulnois...622, 623
„ on W. Defries's and W. Daley's papers 533
„ on Dr. Reid's paper 508
„ on Prof. Roche's paper...... 524
„ on Sir Douglas Galton's paper 538
Symons, G. J., contribution to a bibliography of hygiene, prepared by 89, 275

PAGE

Symons, G. J., on meteorological instruments and sanitary work 157
„ on W. Midgley's paper 697
„ rainfall map of the British Isles 208

TABLE showing amount of sulphur found in air of Town Hall, Manchester, during a year 233
„ showing organic matter in the air at Owen's College, Manchester, on certain dates 234
„ showing death-rate from pulmonary diseases in Manchester and Glasgow 234
„ showing monthly total of fogs, 1876—1890 235
„ of analysis of clay from the Lambeth Cemetery 574
„ giving particulars of pumping stations of new red sandstone wells in Lancashire 580
„ showing air temperature, &c., at Greenwich 204
„ amount of evaporation in various parts of the world 208
„ annual mortality from enteric fever and diphtheria 11
„ average composition of sewage 590
„ death-rate from zymotic diseases in Liverpool, from 1870—93 355
„ the death-rates in various towns since the commencement of the tub and pail system 672
„ infant mortality where young married women are engaged in factories . 500
„ mean monthly rainfall in London from 1813—72... 210
„ meteorological observations 168
„ population per acre at different dates in Liverpool, Manchester, and Glasgow 354
„ the principal features of the water supply drawn by Liverpool from Lake Vyrnwy 365
„ annual death-rate per 1000 in London, &c., in 1854 and 1891–4 654
„ results of analysis of the air of Liverpool 743

PAGE

Table of hygrometrical readings taken in cotton mills ... 695
„ of six densely populated towns and six not so densely populated, 1892, showing birth-rate and death-rate per 1000...658, 659
„ referring to our food supply, frozen, or of home produce ....737—741
„ relating to the operatives in the alkali works of Widnes and Oldbury......715, 723
Tate, Frank, on cold storage, its effects upon our food supply... 731
Temperature of air 180
„ average fall of, with increasing height 181
„ changes in fresh water lakes 177
„ of places for any day, comparison of 182
„ of soil, water, and air, by Hugh R. Mill 169
„ varieties of, in the British Islands 185
„ in water, seasonal changes 196
„ of the whole ocean, average 179
Temperley, C., on Major Isaacs' paper 152
Terry, Hubert L., on notes on town smoke 744
„ on H. Fletcher's paper 757
Thermal changes of gases 171
Thermometer, description and uses of the dry and wet bulb.. 202, 206
Thermometers, description and varieties of 159
Thomas, Councillor R., on Sir Douglas Galton's paper 539
Thorne, R. Thorne, on the etiology, spread and prevention of diphtheria 7
Thornton, Mr., on Dr. F. J. Waldo's paper... 34
Town refuse, destruction of 358
Town smoke, notes on, by Hubert L. Terry 744
Tubercle bacilli, description of 433
„ contagious nature of......... 445
„ preventive measures against 442, 446
Tubercular disease, prevention of 430
Tuberculosis, preventive measures for stamping out, by Dr. T. Whiteside Hime 564
Tub and pail system, the, by George J. C. Broom 664
Typhoid bacillus, characters of 347

PAGE

Typhoid fever, etiology of 343
„ „ nature of the disease, poisons 243
„ „ the spread of, by sewers, by Prof. A. Roche 520

UNITED STATES, sanitary matters in the, by Col. G. E. Waring 264

VACHER, Francis, address to Conference of sanitary inspectors, by 409
„ on W. Defries and W. Daley's papers 534
„ on W. Henman's paper...... 649
Vallin, Dr. Emile, on Hygene at Paris and in France generally 259
Velocity of wind, apparatus for determining the 164
Ventilation of bakehouses, necessity for the 32
„ and lighting of dwelling rooms 50
Vickers, Mr., on Dr. F. J. Waldo's paper 35

WALDO, Dr. F. J., on the sanitation of places where food is stored and prepared 21
Walker, James, on domestic boiler explosions and cylinder collapses, their cause and cure ... 663
Walsh, Dr., on Dr. F. J. Waldo's paper 34
Waring, Col. G. E., on sanitary matters in the United States... 264
Water, effect of heat on........... 172
„ kinds of micro-organisms in 375
„ seasonal changes of temperature in 176
„ sedimentation, effect of ... 249
„ vitality of disease microbes in 245
Water supply of the Borough of St. Helens, Lancashire, by Professor Edward Hull 578
„ „ effects of floods in rivers on the 255
„ „ of Liverpool, improvements in the......355, 362

PAGE

Water supply of Liverpool from Lake Vyrnwy, table showing principal features of the 365
„ „ of London, necessity for improvement in the 366, 370
„ „ by Prof. H. Robinson. 575
„ „ to the working classes, need of soft............ 407
Watson, Dr., on Prof. Roche's paper 525, 526
Wells, new sandstone, in Lancashire, analysis of water from 583, 584, 585
Wheatley, Dr., on Dr. Reid's paper 504
Williams, Dr. C. Theodore, on the climate in relation to health... 216
Williams, Dr. Austen, on Prof. Roche's paper 526
Williams, Dr., on Prof. Roche's paper 524
Williams, Dr. Dawson, on the Eleventh International Medical Congress at Rome, 1894..... 266
Williams, Robert, on the nation's wealth 652
Willoughby, Dr., on Prof. Roche's paper 525
„ on Sir Douglas Galton's paper 540
Willow farming as a profitable means of utilizing sewage effluents, by Arthur Kent 635
Wind, beneficial influence of, on health 222
Wind velocity, apparatus for determining 164
Winds, effects of East, on the human body 205
„ origin of the ordinary names of 199
„ the physiological action of 193, 195
„ varieties of dry and wet 197, 198
Wood pavements, evils of ... 142, 147
Woods for paving, differences in quality of 149
Working classes, lecture to the, by Sir James Crichton-Browne 430

YATES, O. V., on R. Williams' paper 661
Young, Keith D., on sanitary building construction 37

RA421
S3
V.15
1894

Stanford University Libraries
3 6105 015 297 323

DATE DUE

STANFORD UNIVERSITY LIBRARIES
STANFORD, CALIFORNIA
94305